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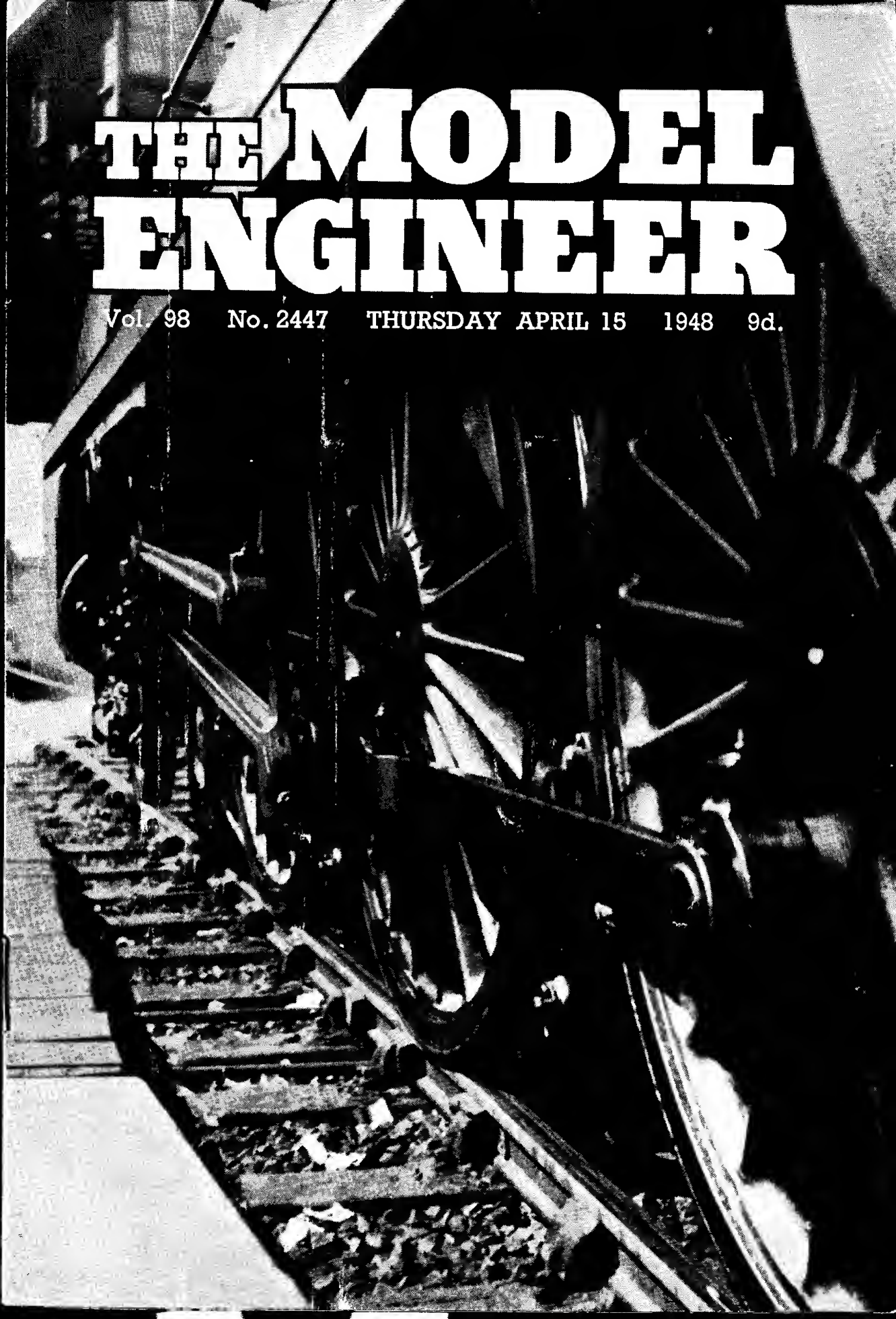


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST. LONDON, W.C.2

15TH APRIL 1948 VOL. 98. NO. 2447

SMOKE RINGS

Our Cover Picture

● OF ALL the many parts of a modern steam locomotive, none is more impressive than that collection of driving-wheels, coupling-rods, connecting-rod and valve-gear, through all of which the potential power of high-pressure steam is transformed into tractive effort. Mr. C. R. L. Coles has captured an imposing study, reproduced on our cover this week, showing the wheels and motion of a Southern "King Arthur" class engine. Incidentally, model locomotive builders should study the tyres of the wheels!

A Dream Come True

● SOMEWHERE AT some time to most of us there comes the desire to escape from the rough and tumble of wresting a living from this crazy world of international strife and mistrust, with its threats of atomic and bacteriological warfare. But few can ever hope that their dreams will become reality, and so, whilst reading a letter from Mr. Newman, who writes from a place called Nambucca Heads in Australia, I found myself mentally transported to the Utopian environment which he describes with these words :—"At long last I have just landed the Drummond lathe that I bought in England in 1934 and have never used. I have had to make up my mind as to whether or not it pays a man to have a good job and travel, or to take less and settle down. Having found at last a part of the earth that is as near to the Garden of Eden as can be, I have taken a very humble job and bought some land to make myself free. I intend to build a very nice workshop with all its blessings and, for that matter, its headaches, too. And now at nights when I rest awhile from my hobby, I can hear the great Pacific ocean thundering on the beach below, and away from the daily papers as we are, the world seems strangely peaceful."

An Exhibition for Charity

● READERS IN the Edinburgh area will be interested to learn that a model railway exhibition is to be held at Leith Links, Edinburgh, from May 22nd to 27th. The net proceeds of this exhibition will be devoted to the Soldiers', Sailors' and Airmen's Families Association and will comprise a number of first-class models, including a 10¼-in. gauge passenger-hauling model of the "Coronation Scot," built by Mr. Ernest Dove of Nottingham who is organising the show. Other models in the exhibition are :—G.W.R. "Hall" Class in 10¼-in. gauge; 1½-in. scale L.M.S. "Duchess" Class, "The Duchess of Portland"; L.N.E.R. "Flying Scotsman"; Southern Railway "Schools" Class; L.M.S. "Royal Scot" and L.N.E.R. "Atlantic" Class, all of which we think would be of interest to local railway enthusiasts.

A Vital National Need

● INCREASINGLY, THE vital importance of paper as a raw material of industry makes itself felt. In one form or another it is an essential commodity in the conduct of every industry or profession. We are advised by the Board of Trade that the present situation with regard to paper supplies is critical; unless there is an increase in the salvage of waste paper or the importation of wood pulp the danger of a breakdown in the normal operation of business activities and, more particularly the production and distribution of trade, technical and specialised journals become imminent. The fibre contained in waste paper is wanted for making new paper, for the essential wrappers, cartons and containers for goods distributed both at home and abroad. Thus, waste paper plays an important part in the export effort. Commercial concerns can play an important part in increasing salvage. Investigation has shown that in by far the greater number of matters in which a business man or firm are concerned, the documents cease to be of the slightest importance as soon as the transaction is completed. It is only in an infinitesimal number of cases that documents will be required after, say, two years from the date of the transaction. Waste paper merchants will supply bags if required and will collect quantities from a few cwts. to an unlimited number of tons and will pay the following prices :—

	Per cwt.
Old ledgers, account books, etc. . .	8s.
Office letters, records, invoices, etc.	7s.
Magazines and Books	7s.
Newspapers	8s. 6d.
Mixed Office Waste	4s.

If there is not a local merchant the Waste Paper Recovery Association, 52, Mount Street, W.1 (Telephone : Grosvenor 3233), will supply the name of one in the district. For domestic salvage, most local councils operate a scheme. If documents are confidential, a guarantee can be obtained from the merchant to ensure safe handling and disposal. In exceptional circumstances it can be arranged for a representative to attend at a paper mill to see the documents destroyed. As publishers, we are naturally vitally concerned with the shortage of paper, and we feel that it is only by a conscientious and concerted effort that we shall survive the present period of scarcity without suffering further cuts in our supplies.

Some Words of Advice

● MY MAIL very often brings me a letter from the secretary of some small provincial society telling me, in effect, that the society's first exhibition, held last year, was so successful that another has been arranged for this year; and, please, could I say where it might be possible to obtain the loan of any models to show! A letter of this kind always enables me to visualise the sort of thing that has happened; the first exhibition attracted large numbers of the public, added a very useful increment to the small society's somewhat meagre funds and generally proved to be such a success that the decision is immediately made that the exhibition must be repeated next year. It is then that the difficulties become apparent, because there are few model engineers who are able to find the time required to make even one new model every twelve months. The result is that, when preparations for the second show are in hand, the organisers are faced with the problem of how to avoid making the second show an almost exact repetition of the first one. The public is notoriously fickle, expecially with regard to exhibitions, and does not always take kindly to being invited to visit what it assumes to be a new show only to find the same models that were on view before. Such a situation is unfortunate for the society concerned, but can be to a great extent avoided if a little care and restraint are applied to the *first* show. Too often, in the flush of excitement and enthusiasm, every model of any kind in the district is hunted down and put into the show; all the eggs are in one basket, as it were. When the time for the second exhibition comes round, little can be found that is new. A better scheme, when organising an exhibition for the first time, is to make a careful selection of exhibits, concentrating more upon quality than on quantity; in this way, a more modest but decidedly more impressive show is bound to be the result, so far as the work of the members is concerned. In addition, variety and attractiveness can usually be enhanced by the inclusion of official and demonstration models, or small apparatus, from local engineering firms, transport undertakings, railway works or other relevant concerns which may be situated in the district. Much can be done also by inviting the collaboration of other clubs in nearby areas; though here, again, some degree of selection should be exercised, so that there may be some possibility that a steady variation of exhibits for future occasions can be assured. There are, of course, almost bound to be found in any district a few models which, by the excellence of their workmanship are well worth being shown time after time, if only because of the inspiration they give to less skilful modellers; such exhibits should never be debarred, since their influence upon the hobby generally is incalculable.

If You Move

● WE RECEIVE a number of letters from registered readers who find themselves unable to obtain their regular copy of THE MODEL ENGINEER as a result of having moved from one district to another. Whilst there is little that we can do once the supplies have ceased, provided twenty-one days notice of an impending move is given to our Sales Manager, we can arrange for the supply to be transferred. Written notification should give the names and addresses of the newsagent and his wholesaler in the district in which you reside, also the names and addresses of the newsagent and his wholesaler in the district to which you intend moving.

Percival Marshall

Building a 3⅝-in. Centre Lathe

by E. W. Brennand

THIS is an article on the lathe which was awarded the Championship Cup in the general class in THE MODEL ENGINEER Exhibition of 1946. It is prefaced by a brief account of my model engineering career, and then in dealing with the lathe itself I have given the history of its design and construction, dealing with the difficulties which arose and the ways and means by which they were overcome.

Under present-day conditions some readers may contemplate building their own lathes, as being the only way of acquiring them. Probably, few, if any, would contemplate the building of a lathe of the complexity of the one described. For this reason no attempt has been made to provide working drawings and instructions for making the complete tool. It is hoped, however, that this article will be of assistance to those who may want to build a lathe for themselves, or who wish to rebuild or improve one which they already possess. It is hoped, too, that the brief descriptions of the methods employed to machine the main components will be of help to those who have similar problems to face, since the principles involved can be applied to types of work quite unrelated to lathe making.

Now it will readily be appreciated that a great many problems will arise in connection with a job of this nature and particularly so when its size is taken into consideration, and it was this question of size which provided the greatest difficulties. So much special apparatus had to be made to enable some of the machining to be done, that it would be out of the question to give a complete description, but the writer will endeavour to convey as much information as possible compatible with reasonable brevity.

There is little to tell concerning my own model engineering history. I do not regard myself as a "model engineer," for the simple reason that I do not make models. I have always taken a great interest in what may be termed light engineering, and I suppose I am more interested in machinery and tools than in the models which can be made by their use. It is in machine work and the devising and making of tools and apparatus that I find my chief interest.

My father had a small room in the house which was my first home, and which was set aside as a workshop, in which he had a collection of tools, chiefly for woodworking and leather work, at which he was very skilled. The tools for metal work were few, and, from what I can remember, very poor, but it was these which interested me most and I was always ready to assist (if my efforts could be called assistance) when any filing or drilling had to be done. As soon as I left school and had earned some money of my own, I bought a small plain lathe of some 2½-in. centre height which I discovered was for sale in a small engineering and repair shop near my home. This lathe had a wood stand fitted with treadle gear, was fitted with a self-centring chuck, and was sold complete with a set of cutting tools. The whole thing was a complete mystery to me, since I had never used a lathe before. It had a front bearing designed on the Schiele curve principle—the only one, in fact, that I have ever seen—and this I found, even later, very difficult to adjust, but I was, of course, very unskilled. It took me some time before I found out the principles on which the cutting tools were designed, as I knew nobody who could use a lathe and give me some help, but I managed to worry the matter out and eventually succeeded in making up tools myself as required.

A year or so after the purchase of this lathe

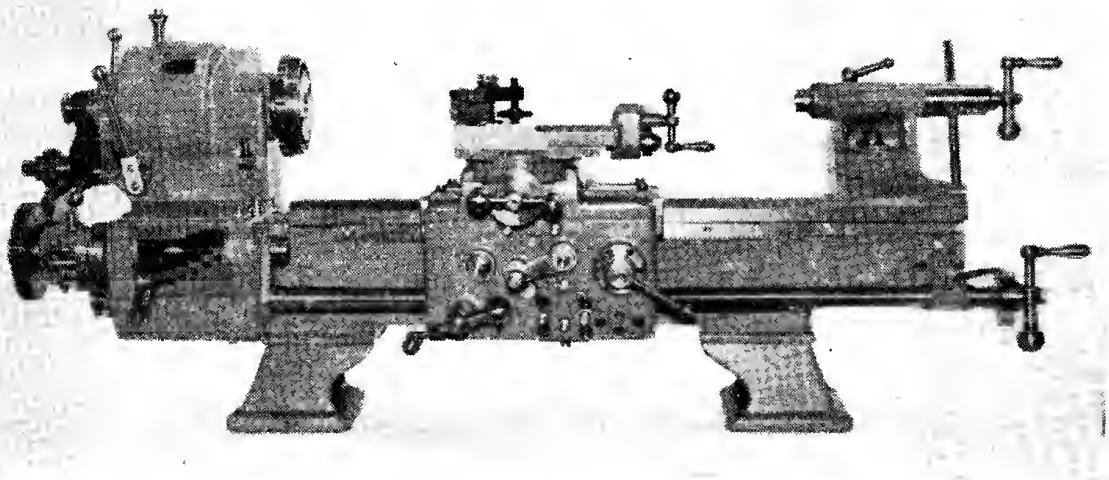


Photo. No. 1. A general view of the complete lathe

my engineering activities were ended by my joining the Forces (1914 war), and a little later the lathe was sold. On returning to civil life in 1919, I started a collection of tools and soon purchased a new 4-in. Drummond lathe and with this as the chief item of equipment, my workshop was started once more. All my work at this time was devoted to making equipment for this lathe and the workshop generally, and I also found much to occupy me in the shape of repair jobs to friends' motor-cycles and the like—jobs with which most model engineers become very closely acquainted. In 1923 I joined the Society of Model and Experimental Engineers, and I regard that (from an engineering point of view) as the best thing I ever did. An inspection of the work done by members of this society gave me a standard to work to and, moreover, membership brought me into contact with skilled workers who were ever ready to assist and advise the less experienced. The equipment in the society's workshop I found invaluable.

Later I took an active part in the society's affairs, serving for some time on the workshop committee, also on the council, and later as Vice-chairman and then Chairman. As a member of the workshop committee, I found ample and interesting work servicing and repairing the machine tools, and making various appliances for use in the shop.

No Workshop

In 1926 a change of residence and business requirements combined to deprive me of my workshop for quite a time, so I sold my Drummond lathe to someone who had need of it, and all my work for the next few years was done in the society's workshop.

When I was able to get my own shop going again I equipped it with a 3⅜-in. Super Exe lathe as the main tool, and this I still have. It was during this interim period that I decided I would design and make a lathe to my own ideas. In 1938 I moved again and once more my engineering activities suffered a setback, but this time I got the best workshop I had so far had. When I bought the house I arranged for the builder to construct a workshop on the end of the garage, and a nice comfortable, well-lighted shop was the result. It has a wood block floor, a light-coloured plaster board covering to the inside walls, and a timber ceiling. I had just about got it in order—benches erected round two sides with cupboard space beneath and the power drive installed—when another war broke out. Thereafter most of the work done was in connection with war jobs. I worked during all the spare time I could find in collaboration with the late Mr. H. G. Eckert (a professional engineer and a MODEL ENGINEER Championship Cup Winner), who was engaged on special work for the Government. For him I made many tools and appliances for special jobs and did a considerable amount of work in connection with experimental apparatus of various kinds. Mr. Eckert was a very highly skilled craftsman and I am very conscious of the fact that my association with him had a most beneficial effect on my own standard of workmanship. His untimely and sudden death at the end of 1946 was a great personal loss to me as well as to the model engineering world in general.

Before I deal with the lathe itself, readers may like to know with what equipment this tool was made. It is a question I am asked by everyone who sees it. Candidly, my home workshop alone could not have enabled me to do the work. I had the use of the S.M. & E.E. workshop with its larger lathes for the heavier work and also its planing machine, without which I should have been helpless. I had also the use of a friend's miller of good capacity which is equipped with universal dividing heads. On this I did all the gear cutting (the rack excepted) and all the heavier milling work. I also had the use of Mr. Eckert's 6½-in. South Bend tool-room lathe on occasion after the end of the war, and it was on this that I bored out the headstock referred to later.

My own shop contains the Exe lathe already mentioned, a Pollard ½-in. bench drilling machine, a Stanley electric bench grinder, a Driver circular saw (this when fitted with a sanding disc and one or two small items is invaluable in pattern making) and now, of course, my own lathe in addition. All the tools are power driven. Of the rest of the equipment, I regard the following as indispensable in the precision work involved in making the lathe: a small surface plate, a straight edge 24 in. long and 2 in. wide (really a long narrow surface plate with a "fish-back" strengthening web), a set of Moore & Wright's toolmakers' straight-edges, a Starrett universal dial-gauge, 1-in. micrometer with vernier reading to 0.0001 in., 2-in. micrometer, a Swiss made vernier calliper gauge reading to 0.001 in., having jaws for outside measurements and also for inside measurements from ½ in. upwards, and a precision hardened and ground square. Other necessary items such as toolmakers' buttons, grinding spindle, lapping equipment and the like, I made myself.

The "Ideal" Lathe

Before describing the lathe itself and the methods adopted in making it, there is one matter which I feel I must mention so that there can be no misunderstanding as regards the design and purpose of this machine tool. Among model engineers a favourite topic of discussion is the lathe and many are the opinions set forth regarding that which constitutes the "ideal" lathe. Now in most home workshops the lathe is probably the only machine tool (though there are many more drilling machines in evidence than was the case some years ago) and consequently that lathe is required to be a universal machine capable of much varied work, in addition to its normal functions of turning, boring, facing and screwcutting. No multi-purpose tool can be as good or as efficient as two or more machines each designed to do only one particular class of work out of all those classes which the multi-purpose tool is expected to handle, and so a compromise has to be accepted. Even amongst one class of tools the best is the one which is best suited to do the particular work in hand. No one lathe can handle efficiently instrument work at one end of the scale and heavy iron castings at the other.

For the model engineer then, with his varied

work to be done on one tool, there never can be an "ideal" lathe. He must choose the one which appears most suited to his usual run of work and accept certain deficiencies as the price paid for other utilities. The writer's lathe, therefore, is not an attempt to find the home worker's ideal tool. It is not a universal tool rack for the carriage movement, leaving the leadscrew threads for screwcutting only. There is an interlocking device which prevents the simultaneous engagement of screwcutting and power feeds. It is unfortunate that no clear way could be seen to provide a power feed on the surfacing motion. This could have been

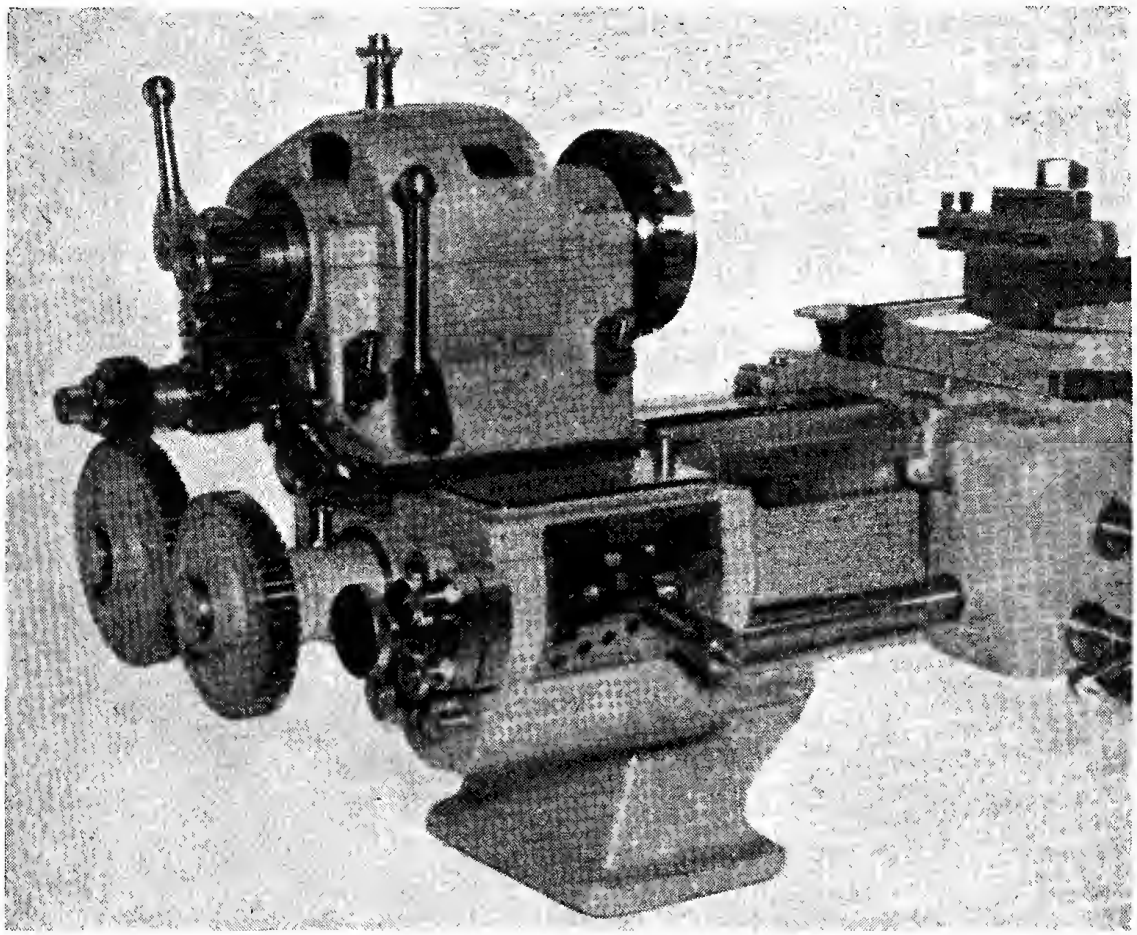


Photo No. 2. Headstock and quick-change gearbox

in the model engineering sense ; it was designed as a lathe only and is an attempt to bring into being what might be described as a small edition of a modern tool-room lathe. The writer's aim was to produce a tool of the average size to be found in the home workshop, but of greater accuracy than the average. To this end it was planned to secure alignments within the limits usually accepted as the standard for lathes of tool-room class. At the same time, convenience and ease of handling was studied and devices leading to time-saving in operation were incorporated, regardless of the complications involved in the making. In this connection a quick-change gearbox, having seven changes of speeds, was fitted to provide for rapid changes of pitch when screwcutting and a range of power feeds. The change from screwcutting to feeding is looked after in the apron mechanism. The leadscrew is splined to provide the drive to the done, but the feeds would have been so slow as to render them practically valueless. The limited space available in the apron made it impossible to accommodate the extra train of gear wheels which would be necessary to step-up the cross feed to a reasonable rate.

In addition to the required accuracy and ease of handling, the lathe was required to be capable of taking a reasonably heavy cut, without fear of overstrain or damage, in order to reduce the time which preliminary roughing-out so often takes on a small lathe. The ability to take load depends on the rigidity of the mechanism concerned and on the fitting of its moving parts. Every part of this lathe had, therefore, been made of substantial proportions and special care has been taken on the correct finishing of its working surfaces. With a view to long life as well as to strength, the materials used have been carefully chosen and are, as far as possible, the best suited

to the functions which they are called on to perform.

Some test figures regarding the alignment secured may be found interesting at this stage.

Parallelism of the two V ways of bed :—No measurable error by the dial indicator throughout their length of 24 in.

Alignment of headstock spindle with bed :—
Horizontal plane—no measurable error in 3 in.
Vertical plane—No measurable error in 3 in.

Alignment of tailstock spindle with bed :—
Horizontal plane : Error about 0.0001 in. in 3 in.
Vertical plane : No measurable error.

Headstock centre height compared with tailstock :
Headstock centre higher by 0.00025 in.

Cross-slide movement at right-angles to centre line of spindle :—
Error (inwards) 0.0001 in. in 4 in.

It must be remembered that however good the alignments of a machine may be when that machine is at rest, they are valueless if they are not held when the machine is at work, i.e., is under load.

The following results were obtained in an actual working test :—

Chuck work :—No measurable error (i.e., less than 0.0001 in.) in a length of 3 in.

Between centres :—Turning 10 in. length, no measurable error in diameter at ends, 0.0001 in. large in centre—probably due to spring of the work.

Facing :—Very slightly concave—about 0.0001 in. in a diameter of 6 in.

Photo No. 1 shows a general view of the lathe as exhibited at the Exhibition of 1946. It is still not quite complete, as the covers for the cluster gear and main gear-train have not yet been made. These should be regarded as essential items. The bed and cross-slide have provision for the addition of a taper-turning attachment, which had been designed but not yet made.

The project began in the late 1920's, when the writer came into possession of a light type of bed, and to this he made and fitted head and tailstock saddle, cross-slide, top-slide and lead-screw. This lathe worked very well and, in particular, the headstock proved very satisfactory, being quite substantially made. It was quite evident that the headstock was capable of work much heavier than the rest of the lathe could stand up to, and as the S.M. & E.E. workshop had just added a 24-in. planer to its equipment, it was decided to design and make a new bed of much heavier pattern, a new saddle and tailstock to match, using the existing headstock, cross-slide and top-slide. It was also decided to fit the quick-change gearbox, which has already been mentioned, of the Norton type.

The conversion was finally completed some twelve months before the end of the war (work being very spasmodic, due to time being very limited, for reasons already explained). In this state the lathe proved capable of very exacting work as regards accuracy, and on the whole was very rigid. However, in the light of experience gained in other directions, it was thought desirable to fit a hardened, ground and lapped spindle in place of the soft one of carbon steel and to replace the gunmetal bearing bushes by cast-iron bushes with lapped bores. The idea led further ; the headstock, which was the best feature of the original lathe was now not capable of transmitting the power that the rest of the lathe would bear with ease, so it was decided to replace the head with one of entirely new design, having a hardened spindle, and in order to have ample power transmission this head was to be fitted, not with the usual cone pulley, but with a single speed pulley, having two grooves for twin V belts. The changes of speed (apart from the back-gear) were to come from a source outside the lathe itself. At the same time it was decided to make a new cross-slide and top-slide more in keeping with the redesigned lathe as a whole.

Work was started on the pattern making towards the end of 1945 ; the job was completed, as shown, a week before the Exhibition opened.

The Bed

It is not possible to single out any main portion of a lathe and refer to it as the most important part. All must fulfil their functions in a satisfactory manner if the whole lathe is to be a good tool. The bed, however, is the foundation on which all else is built and the whole will fail if the foundation is weak. If a lathe is to be satisfactory in operation it must be rigid. All structures will deflect under load and while this deflection cannot be eliminated entirely it can be reduced to negligible proportions by careful design. The bed, therefore, is of very substantial proportions and is well braced. It has two inverted V's on the front shear and two flat slideways on the rear shear ; the front (and larger) V and the rear flat guide the saddle, while the inner V and inner flat form the guides and seating for the tailstock. The bed is 30 in. long and, because the maximum stroke of the available planer was 24 in., a very unusual design was adopted. The headstock is mounted on a separate platform instead of on a V and a flat as would be usual with a bed of this type, there being a gap of about 1 in. between the ends of the shears and this platform. This gap is in no way intended to give a gap bed lathe in the accepted sense—it is far too narrow—and is there merely to give clearance for the planing tool when planing up the bed ways. That part of the bed to which the headstock is bolted is of box form, open only at the bottom, while there are five braces distributed along the remaining length of the bed ; this latter is $5\frac{1}{4}$ in. wide over the shears and $4\frac{1}{2}$ in. deep.

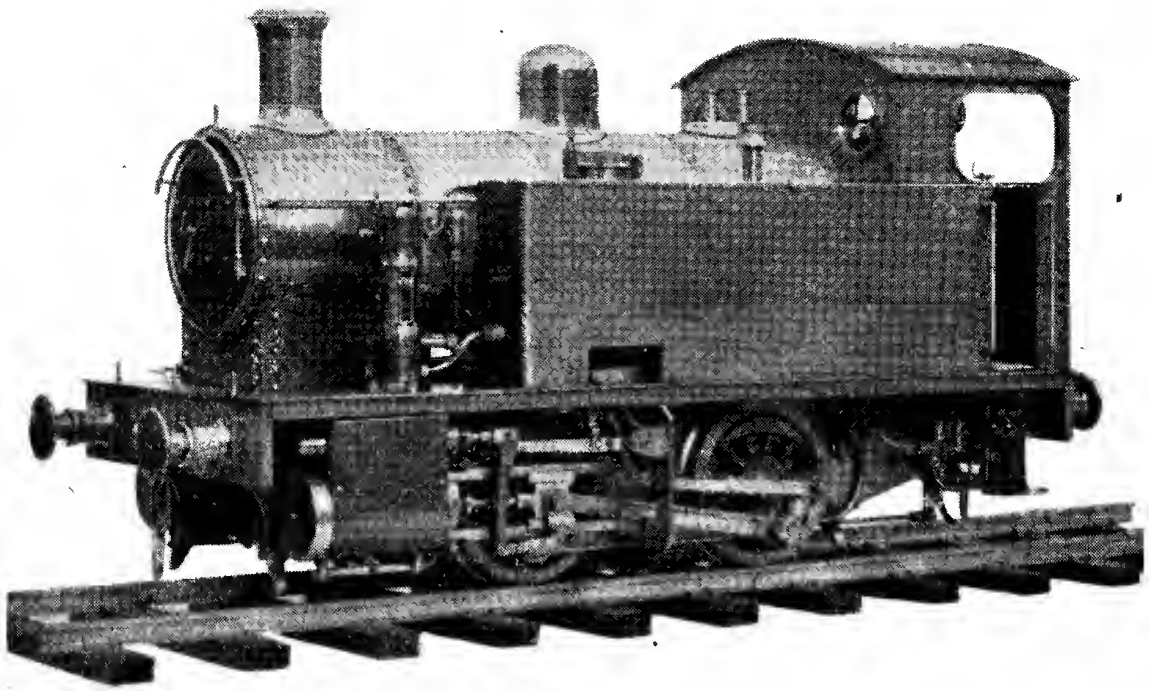
The pattern was made of pine built up from sections and four core-boxes were needed. To save the complication of loose pieces in the pattern, it was arranged that the V's should be planed out of the solid when the casting was machined. A great amount of time was spent in making the pattern and core-boxes—so much, in fact, that when this part was done the writer was inclined to regard the bed as virtually finished. The casting was obtained in Meehanite iron (this was before the war). This iron machined beautifully and was quite free from distortion, even after the first rough planing operations.

(To be continued)

Another Good Job Well Done!

by "L.B.S.C."

REGULAR followers of these notes may recollect the drawings of an 0-4-0 tank engine designed by a Worcester reader, Mr. Jack Cox, for a first attempt at locomotive building, and the references I have made to it from time to time. I nicknamed it "Tail-wagger" on account of the short wheelbase. in these notes about 15 years ago, the steam cylinder being ½ in. bore and ⅝ in. stroke, and the pump cylinder ⅜ in. bore, double-acting. When first made, the pump worked perfectly on compressed air, but when tried under steam, was erratic in action, and would suddenly stop. Expansion of the shuttle under heat was suspected,



Mr. Jack Cox's "Tailwagger"

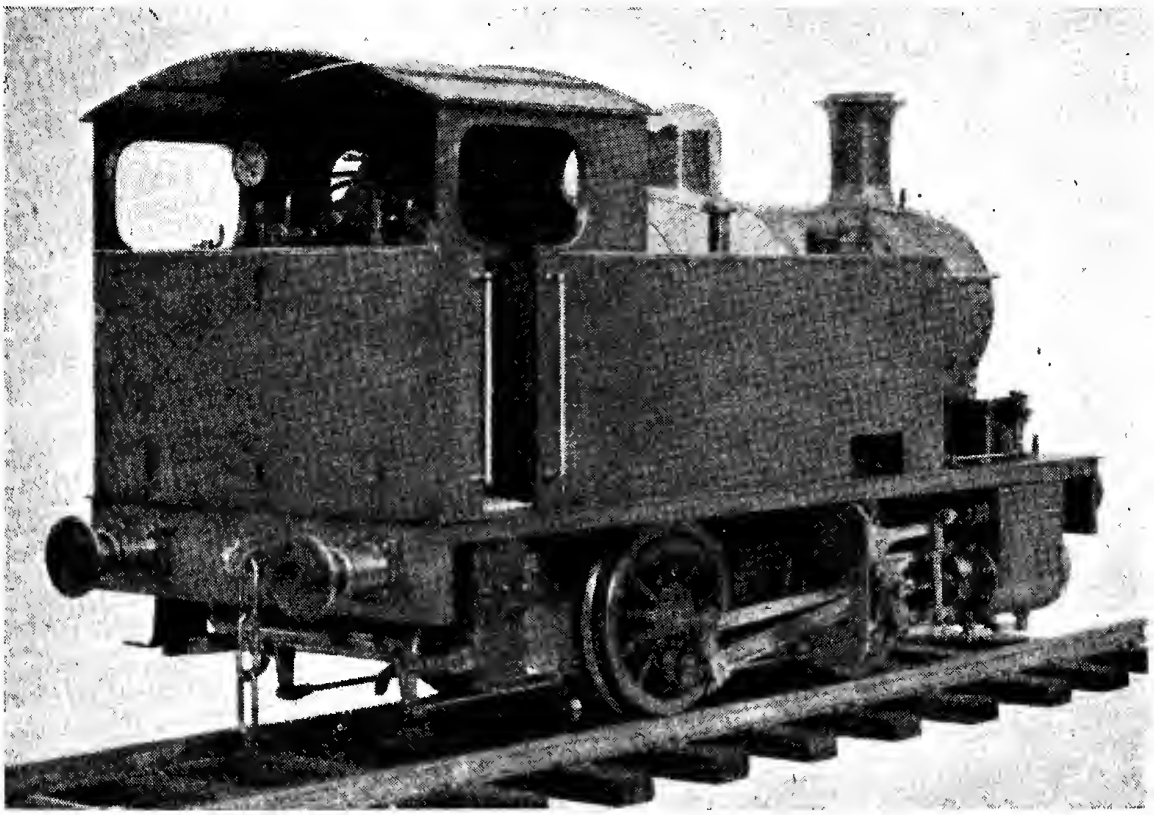
Well, Mr. Cox has now finished the engine, and here are some pictures of her; I guess we can offer congratulations to the builder both on a neat design and excellent workmanship. Maybe a few notes on the finished job may be interesting to those of our fraternity who are building similar locomotives. The original design proved quite satisfactory, the only variations being that the wheelbase was lengthened out to 6½ in. to minimise any tailwagging antics, and the boiler was raised slightly to suit the side tanks. The chief dimensions of the engine were given along with the drawings, so there is no need to repeat here; but our worthy friend has kindly furnished the following information on the details and accessories.

In addition to an eccentric-driven pump ½ in. bore and ½ in. stroke, and the injector which can be seen close to the left-hand footstep, a donkey-pump is also provided for boiler-feeding; and in connection with this, Mr. Cox gives an interesting experience, an example of how it is the little things that matter. The pump is a larger edition of the Weir pattern that I described and so it was dismantled and inspected, but apparently was all right. The trouble recurred, until suddenly our friend found out the cause of the stopping. It may be remembered that the shuttle pistons work in two weeny cylinder bores above and below the main slide-valve, and the ends of these are closed by two plain covers. These were furnished with 1/64-in. Hallite gaskets; and being so small, Mr. Cox left the gaskets as plain discs. They were O.K. on air pressure, as the temperature of the pump was not increased; but as soon as the pump warmed up under steam, the air trapped between the blank gaskets and the little covers expanded, blowing them out like blisters, and effectually closing the ends of the steam passages. A hole punched in the centre of each gasket completely cured the trouble, and the pump now works perfectly.

The feed water from the donkey pump is led to the clack on the opposite side of the boiler, giving a longer and therefore more flexible pipe which is easy to couple up. It may be remembered that I sometimes specify crossed steam pipes

in the smokebox of an engine with outside steam connections to the cylinders, for the same reason. No hand-pump is at present fitted, and with three mechanical feeds would only be used in emergency.

The lubricator is an enlarged version of the one I described for "Juliet," having a pump 5/32 in. bore and ¼ in. stroke. The stand is extended to L-shape at the bottom, to enable the delivery to be taken direct from the front of the oil reservoir, and the check-valve is located in the extension. The drive is rather unusual, the ratchet lever being actuated by one end of a rocking lever running across the tops of the frames, driven by an eccentric on the leading



Open back, plus "sunshine" roof, gives full accessibility

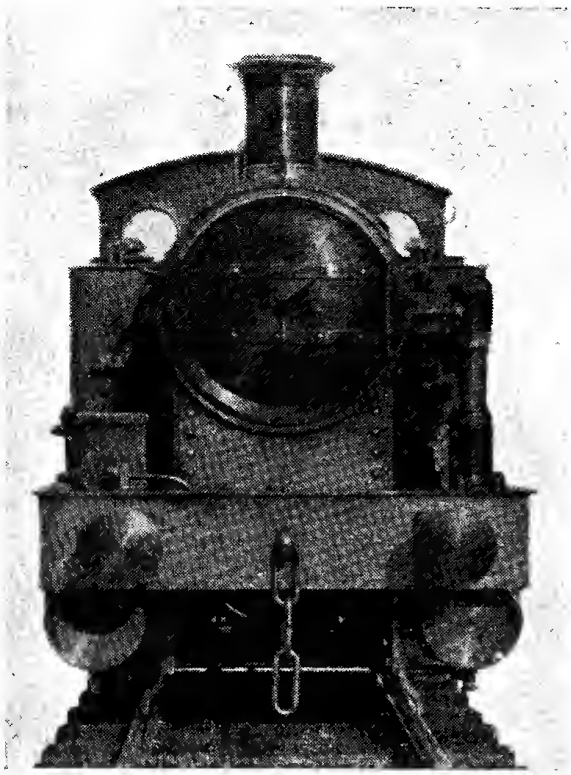
axle; the connection is shown in the view of the right-hand side of the engine.

The brakes are steam-operated, but cannot be seen very well in the photographs, although the end of the steam cylinder can just be seen under the right-hand end of the buffer beam in the back view of the engine. It is ⅝ in. bore, and with the boiler at full working pressure, 85 lb., gives a pressure of 16 lb. between brake-block and wheel. The brake blocks are made of fibre, and the brake rigging is fully compensated.

The cylinder drains are of the poppet-valve type, similar to those I specified for "Maisie," but some trouble has been met through dirt and scale getting on to the valve seats and preventing the valves shutting down properly. Those on the original "Maisie" were just the same until the engine had "settled down," in a manner of speaking, and blown all the dirt away, after which everything was O.K.

The boiler is lagged with a ⅛-in. layer of flannel, covered by a cleading of 28-gauge stainless steel sheet. The dome cover was built up, the top part being made from a piece of brass plate hammered to shape over a former, and silver-soldered to a piece of brass tube. The chimney is detachable; and as a curious confirmation of the old saying about "great minds thinking alike," it is attached in a very similar manner to one on an old Great Northern locomotive which I repaired many years ago for an old friend now, alas! on the other side of the Jordan. This engine was one of Waller Martin's jobs. The flange at the base of the chimney was separate, the chimney barrel being slightly reduced in diameter at the bottom, to pass through it. The projecting part below the flange was screwed, passed through a hole in the smokebox, and entered a tapped ring which was bent to the radius of the smokebox before tapping. To erect the chimney, the flange was placed over the hole in the smokebox, the screwed end of the chimney inserted, and the tapped ring held against same inside the smokebox. Turning the chimney pulled the ring tight up against the top of the smokebox, the flange being tightly clamped between the outside of the smokebox and the little shoulder on the chimney barrel at the end of the reduced part.

Mr. Cox has "turned this job inside out" as the kiddies would put it. His chimney has the loose flange at the bottom, and the chimney barrel is likewise reduced; but instead of being



Realistic!

screwed externally, it is tapped. The top of the liner is screwed to fit; and the ring, bent to the contour of the smokebox, is silver-soldered to the liner just below the screwed part. To erect Mr. Cox's version, the liner is poked up through the hole in the top of the smokebox, from inside, until the ring is bearing hard against the smokebox top; the separate flange is then placed over it, and the tapped end of the chimney barrel screwed on to the liner, clamping the flange tightly between the top of the smokebox and the shoulder on the reduced part of the chimney.

Cab and Footplate

The cab view shows all the footplate fittings quite clearly. The actual regulator is of Stroudley pattern, although an ordinary crank handle is used instead of the double-armed type favoured by "old man Billy." The valve to the left is the injector steam valve, and has an internal steam pipe going to the dome. The lower valve on the left controls the steam supply to the donkey pump, whilst the clack below it takes the feed from the injector. The upper left-hand valve close to the side-tank, is the bypass valve for the eccentric-driven pump, the one under it being the pet-cock for the donkey-pump. The water valve for the injector is of the ordinary screw-down type, operated by a "brake handle" as described in these notes for tender engines.

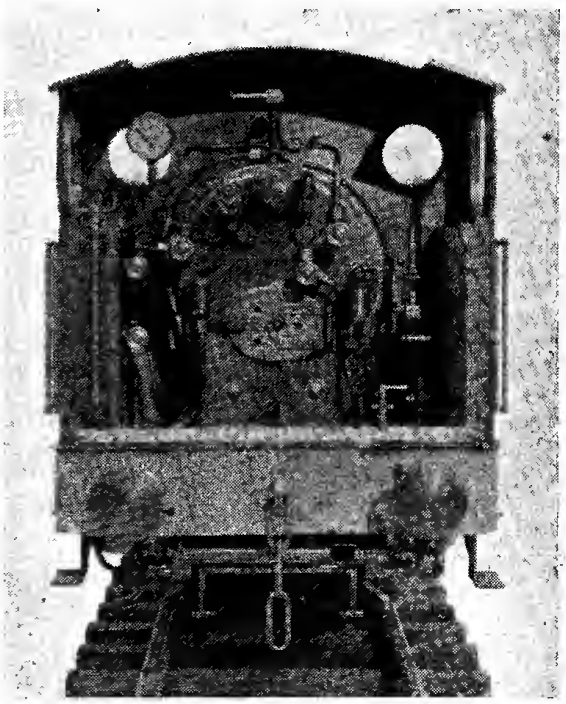
The driver's valve for operating the steam brake is similar to the one I specified for "Petrolea," except that the handle extends right across to the opposite side of the valve, and works between two stops. The lever with a side handle, close to the bottom of the reversing-lever, operates the drain-cocks on the cylinders. The other fittings, whistle-valve, blower-valve, and water-gauge are all made to the specifications given in these notes.

The grate, which is hinged to the front of the ashpan, can be separately dumped by operating the lever projecting up through the middle of the footplate close to the backhead. The complete outfit, ashpan and all, can be detached in the usual way, but owing to the pull-rods for the brake-gear preventing a direct drop, it was found more convenient to use a separate dumping grate. The footplate is covered with a piece of expanded aluminium of $\frac{3}{16}$-in. mesh, and looks very well.

A Ticklish Job

No handbrake has been fitted, though provision for it has been made in the shape of a crank on the left-hand end of the brake shaft; in any case it would be a ticklish job to fit up, as there is little room available for the column and handle. The cab has a sliding or "sunshine" roof, for convenience in getting at the handles and the firehole when running. The engine has not yet been painted; Mr. Cox says he thinks he will wait until there is some better paint available.

The engine has not yet had a chance to show what she can do on a continuous line, but as our friend is a member of the Wolverhampton club, and they hope soon to have a club track in operation, this deficiency will soon be remedied, and I haven't the slightest doubt that the "Tail-



A neat arrangement of fittings

wagger " will give a first-rate account of herself. She is Mr. Cox's first attempt at locomotive building, and has taken about eighteen months to build, which is good going indeed, as all castings, etc., had to be specially made. Our worthy friend says he sincerely hopes she won't be his last, and is at the moment thinking of going in for a 5-in. gauge Southern " Schools " class 4-4-0, as he likes to do a bit of scheming out for himself. He certainly hit the bull's-eye with the " Tailwagger "! Incidentally, much of the work on this engine was accomplished by aid of an old 4-in. Drummond lathe, with treadle drive; but he now has a Myford version of the Drummond 3½-in. lathe, and is fixing up a better workshop with a ½-h.p. electric motor; as he says, a welcome change and a rest!

The " Maid " and " Minx " in 3½-in. Gauge

Several correspondents have written to ask if it would be possible to build either the " Maid of Kent " or the " Minx " in 3½-in. gauge, to suit existing 3½-in. gauge lines, so maybe a few hints on the conversion of sizes would save both time and ink. Either locomotive would make a good 3½-in. gauge job, the general dimensions being reduced in the proportion of 10 to 7, with the following variations. The main frames should still be made from ⅛-in. steel, 3/32-in. being hardly stout enough for a really powerful engine of this size intended for hard work. There is a lot of misconception about the stresses a little frame has to put up with. I might confess that if I personally built either " Maid " or " Minx " in 5-in. gauge as described, I should do my utmost to get hold of some 5/32-in. plate for the frames; the only reasons for specifying ⅛-in. in the notes, was that the thicker size is practically unobtainable at the present time, and both engines are comparatively small types, so that the thinner plates would stand if well stayed. You will, of course, have noticed that I specified a substantial cross stay ahead of the firebox; and the motion plate to be described, will form another hefty brace. Thin frames may be all right on paper, but it is a different tale on the road—some of the engines I have rebuilt in the last twenty years have been shining [?] examples of that! It hardly seems credible, but once at Swindon Works I saw a 2-8-0 frame (" Lady Kitty's " big sister) bent practically 1½ in. out of the straight; and nobody could accuse Swindon of " skimping," so you can guess to what stresses that huge slab of metal had been subjected! Consider how much sharper the curves are on a little railway, and how the engines deal with outsize loads, and put two-and-two together for yourselves; experience still is the finest of all teachers.

The 3½-in. gauge frames should be 2⅞ in. between, and the buffer and drag beams can either be castings, or made from 1-in. by ⅛-in. angle. I should prefer to braze the frames into the slots in the beams, if angle is used. The horn-blocks and axleboxes specified for " Molly " would suit both goods and passenger engines; the " Lassie " horns are too big. " Molly's " crank axle, or " Petrolea's " ditto, would do fine with eccentric sheaves complete. " Molly " cylinder castings could also be used, turned up the other way. The bogie and coupled wheels of the " Lassie " would come in for the " Maid," and the coupled wheels of " Molly " or " Iris " for the " Minx." Incidentally, those good folk who keep on sending direct to me for information about the dimensions of locomotives which have been described in back numbers, saying that they have either lost their copies, or can't get them (if new readers), may be glad to learn that Mr. Roy Donaldson is getting well down to the job of making blueprints of the engines described in these notes, and hopes eventually to supply the whole range, for sale by our advertisers. As I have two big steamer trunks chock full of my original drawings, he looks like having an exceedingly busy time for the next year or two!

Valve-gears and Boilers

Although I haven't yet drawn out the valve-gears, nor the boilers for the 5-in. gauge engines, it will save time for 3½-in. gauge builders if I mention here that the valve-gear of " Petrolea " (link motion) or " Miss Ten-to-Eight," the North Eastern R1 (Joy gear) would come in for the 3½-in. " Maid " and " Minx," with a little adjustment, the rocking levers which I shall specify for the link motion engines being retained, and reduced in the proportions named. The boiler barrels would be 3½ in. diameter, with the tube and flue arrangement specified for " Juliet "; this gives a boiler with ample steaming capacity, and I have used similar boilers on my own engines " Jeanie Deans " and " Grosvenor." Anybody who prefers a fatter barrel, can use it by all means, still keeping to the same arrangement of firebox and tubes. I think the above general hints will be found useful to those good folk who want to build the engines to 3½-in. gauge. I haven't forgotten my promise to " work in " the description of a L.M.S. Class 5 4-6-0, one of the most efficient types of locomotive ever put on rails (AND the valves have exhaust clearance!);

Correspondents Ahoy!

May I once more state for the benefit of new readers and others, that it is a physical impossibility for me to make drawings and give direct postal instructions to individual readers. Only this week, time of writing, I have been asked to supply sketches and instructions for making (1) a 3½-in. gauge Westinghouse pump, brake cylinders, and triple valves; (2) oil-fired boiler for a steamboat; (3) boiler and " works " for an " OO "-gauge " Pacific " steam locomotive; (4) single-cylinder gauge " 1 " 4-4-0; (5) single oscillating-cylinder " O "-gauge child's toy locomotive; (6) boiler for 1½-in. scale traction engine (from one extreme to the other!) and last but not least, I received the outline drawing of a Colonial engine with a request to pencil in the dimensions for a 3½-in. gauge edition. Practically all these requests were prefaced with an apology for taking up " a few minutes of my time "!! Good folk who write thus, seem to jump to the conclusion that because they read my notes in a few minutes, it only takes that time to write them; well, jumping to conclusions is often fatal.

A Chemical Balance from Scrap

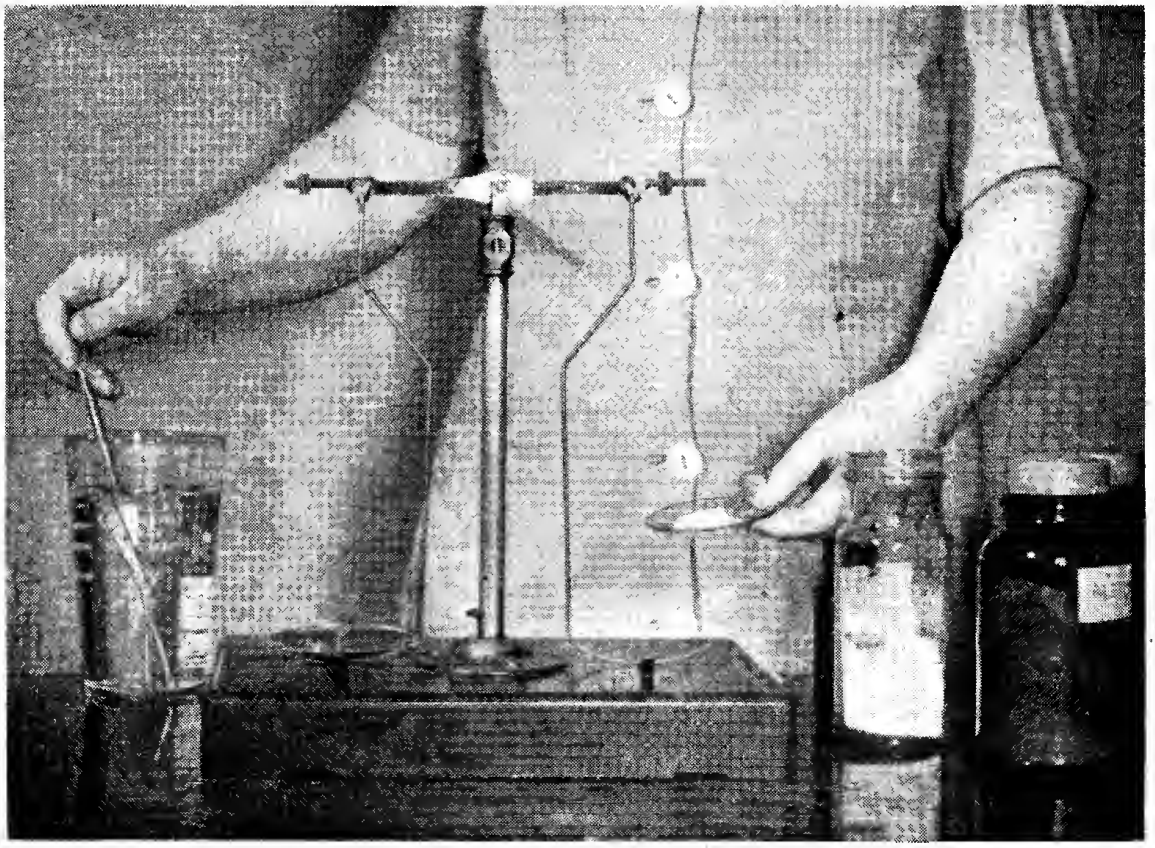
by G. E. C. Webb

IT is not long before every photographer finds the need for a chemical balance, and the photograph below shows one which was made from an old pendant gas-light fitting. Many junk boxes contain one or more of these fittings, and, in any case, they can usually be obtained from a junk shop for a few coppers.

The centre column of the balance was made from one half of the pendant, with the taper plug of the tap removed. It was screwed into the circular brass ceiling plate of the gas fitting, which was in turn screwed down to the wooden base. The base is in the form of a shallow inverted box.

The beam is the crossbar of the gas tap. It already had a hole in the centre and a heart-shaped hole in each end from which the chains had been suspended. A $\frac{3}{16}$ in. Whitworth screw with the head cut off

was soldered on to each end of the beam. These screws project $1\frac{1}{4}$ in. beyond the ends of the beam and each is provided with two nuts. By screwing the nuts nearer to or farther from the centre of the beam, perfect balance can be easily attained. The balance wheel from an old clock movement was soldered to the centre of the beam and the two pivot bearings from the same clock were silver-soldered, one each side of a square of brass sheet, to form a channel-shaped piece. This was then soldered to the end of a piece of steel rod, which stands upright in the centre of the column. The result was a good sensitive point of balance for the beam. The centre rod carrying the beam can be moved upwards by means of a small plunger at the front of the base, *via* a lever on the underside of the base. This allows the pans



to rest on the base when the balance is out of use, and to be raised as required. The centre rod was a motor-car wheel spoke, and one which fitted the hole through the tap into the column was found by the simple expedient of taking the column to the nearest garage and selecting the spoke by trial.

The pendants for the pans were made of 13 gauge brass wire with + shaped pieces of 24 gauge sheet brass soldered to the lower ends, on which to rest the pans. The pans are cycle lamp glasses, 3 in. in diameter, and they cost 2d. each about three years ago.

A box of grain weights up to half an ounce were received as a present when the balance was made, so that the original intention to make the weights was not carried out. The idea was to use the tables to be found in almost any engineer's pocket book, giving the weight per yard of the various gauges of copper wire. A simple calculation will show the length and gauge of wire needed to weigh, for example, 5 grains. This could then be rolled into a coil and weighed on the balance against a piece of brass on which would be engraved the number "5." Provided that the brass weight is made slightly too heavy at first, it could be balanced accurately against the wire weight by gradually filing it. In this way a full set of weights could be made.

The balance has been in service for over three years and has proved very satisfactory. It took only about two hours to construct and the total cost was 4d. for the pans. All the other material came from the scrap box. It is sensitive to about 2 grains (plus or minus), which is quite good enough in practice. The small photograph is a close-up of the beam, showing the pivot bearings. The beam is raised to show the centre rod.

For the Bookshelf

The Battery Book. By Harold H. U. Cross. (London: The Technical Press Ltd.) Price 8s. 6d., postage 6d.

This book deals in a practical way with the types of batteries in common use, with special emphasis on the modern "storage battery" or accumulator. It begins with a description of the "dry" battery, and proceeds to the lead storage battery, including the large electric-vehicle battery, and the smaller batteries used for lighting and ignition on motor vehicles. The charging and maintenance of these batteries is dealt with, also their repair and servicing. A chapter is included on the alkaline battery, and another on unusual types of accumulators. The book concludes with an appendix of technical information and a glossary of terms used in the text.

Introduction to Wireless. By W. E. Pearce. (London: G. Bell & Sons, Ltd.) Price 7s. 6d., postage 6d.

Despite the many books which have been written on this subject, there is still scope for new and up-to-date information, especially in view of the ever-widening developments in the field of short-wave telephony, television and radar. This book deals in a lucid manner with the basic principles and essentials of wireless apparatus, but is comprehensive and fully up to date, and can be recommended to all serious students who wish to explore the subject thoroughly from the groundwork upwards.

Speed from Your Motor Cycle. A *Motor-Cycle* handbook. (London: Iliffe & Sons Ltd.) Price 3s. 6d., postage 3d.

Although nearly all motor cycles are at present in cold storage as a result of fuel restrictions, it is a mistake to assume that they should be forgotten during this temporary inactivity. On the contrary, there is every reason why the serious enthusiast should take this opportunity to studying every possible way of improving his machine, in preparation for obtaining the best results from it when it is once again possible to put it into service. The pursuit of sheer speed, may, possibly, be open to criticism, but it is really the study of high efficiency, and the rider or mechanic who knows the secrets of tuning for speed is certainly well qualified to deal with the everyday problems of repair, servicing and maintenance of motor cycles. Much of the information in this book is applicable to any type of motor cycle, and also to cars; it explains not only the essentials of engine tuning, but what is even more important, how to improve transmission efficiency, and ensure that as much as possible of the power developed reaches the driving wheels.

The Electrical Handicraftsman and Experimenters' Manual. By H. R. Langman and J. H. Moore. (London: The Technical Press, Ltd.) Price 10s. 6d., postage 6d.

We welcome the reappearance of this handy and practical work, which was originally published before the war, but is by no means out of date now. Its sub-title "a new practical *vade-mecum* for all experimenters, inventors, students, and all interested in the construction of electrical mechanisms, appliances and experimental apparatus," adequately describes its contents. Examples are given of a wide variety of electro-magnetic devices, contact-making mechanism, demonstration models for illustrating basic electrical and mechanical principles, for use in the laboratory or classroom, and many other devices of interest to the student or research worker. The book is profusely illustrated with line drawings, and while some of these may be open to criticism on the grounds of rather heavy or untidy draughtsmanship, they never fail to achieve their object of elucidating the working principles of the devices they portray. Both the quantity and wide range of the subject-matter represent excellent value for money.

Modifications for the M.L.7 Lathe

by A. R. Turpin

HAVING taken delivery of one of those excellent little lathes—the M.L.7—about nine months ago, a number of modifications suggested themselves whilst executing some repetition jobs on it, and the writer feels that these might be of interest to others.

The first was a screw-cutting job, and a number of different threads had to be cut at one setting; this necessitated the continual change of the gear train. This is a simple enough operation when it has to be done only occasionally, but the removal of 2-B.A. screws, and the loosening of two nuts—which are rather awkward to get at when the lathe is bench mounted—is apt to waste considerable time and become somewhat monotonous when it has to be done often.

The writer felt that a method of fixing the stud that would be somewhat simpler could be devised with a little thought, and, finally, the arrangement shown in Fig. 1 was decided upon. No dimensions are shown, as in the main they

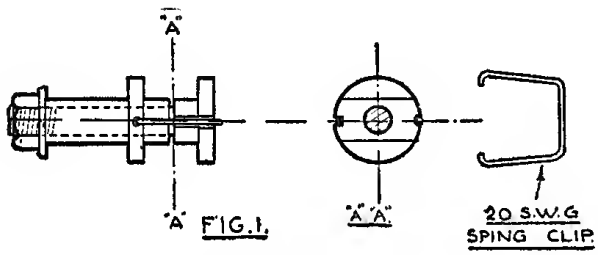


FIG. 1.

will be the same as the existing studs, and the others are obvious.

The new stud is made in two parts, the stud proper which has a ¼-in. clearance hole drilled right through it, and the bolt which is ¼-in. B.S.F. Both are turned from ¾-in. high-tensile steel, and hardened and tempered when finished.

The bolt has a ¾-in. head $\frac{5}{16}$ in. thick, and $\frac{3}{16}$ in. of this thickness is machined down to make a flat to fit the slot in the "banjo."

A similar flat and flange are machined on the stud. It is as well to machine these two flats with the stud assembled, so that they will be in true alignment when in the slots.

To prevent the stud and bolt coming completely apart when the nut is removed, a 20 s.w.g. spring clip holds the two pieces together, the open ends of the clip being located in holes drilled in the periphery of the stud flange, and the arms of the spring passing through slots in the head of the bolt.

When changing wheels with this type of stud it is only necessary to remove the nut, which is now on the front of the change wheels, replace the wheels, slide into mesh and screw up the nut again.

The next job was the turning of a number of tapers of opposite hands, and on this lathe to set the top slide for an opposite taper the two holding-down nuts must be removed, the top slide lifted clear and the bolts slid over to the opposite sides of the boring table.

Whilst doing this, chips and swarf usually get all over the place and have to be brushed off. The top slide has then to be replaced and bolted down.

To overcome most of this trouble, two bars

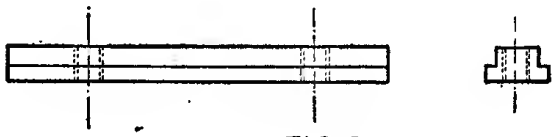


FIG. 2.

were machined as shown in Fig. 2, so that they are a nice sliding fit in the tie slots of the boring table, they are then drilled and tapped ¼ in. B.S.F. High-tensile bolts are used to hold the top slide down.

To change tapers with this arrangement, it is only necessary to unscrew the bolts from one set of tapped holes and screw them in the other. If the hole is filled with chips it can be easily cleared by sliding the bar just clear of the boring table, or alternatively, the holes may be drilled at such a distance apart that the unused hole is covered by the base of the top slide.

If considerable use is made of the "set over" of the tailstock, it will be found that the slots on the adjusting screws soon burr over, Allen screws were used to overcome this.

It is difficult to centralise the tailstock after taper turning with any accuracy when the scale supplied is used, so a new adjusting screw was made, as shown in Fig. 3. This replaces the

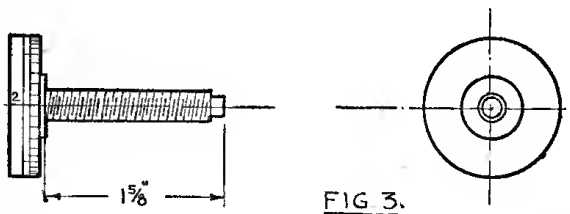


FIG 3.

adjusting screw at the back of the tailstock. This vernier screw consists of a length of silver-steel, screwed ¼-in. B.S.F., and turned down at one end clear of the thread for ⅛ in. The other end is screwed and brazed into a mild-steel disc 1¼-in. diameter, the periphery of which is divided into 40; as the screw is 26 t.p.i. this

(*Continued on page* 414)

LOCOMOTIVES WORTH MOD

No. 25—L.B. & S.C. R

JOHN CRAVEN was a scintillating engineer. From his lively imagination locomotive designs flew as freely as sparks from the anvil! When he resigned from his post at Brighton after a little over twenty years' service, the L.B. & S.C. Railway found themselves the proud possessors of no fewer than 72 classes of engines!

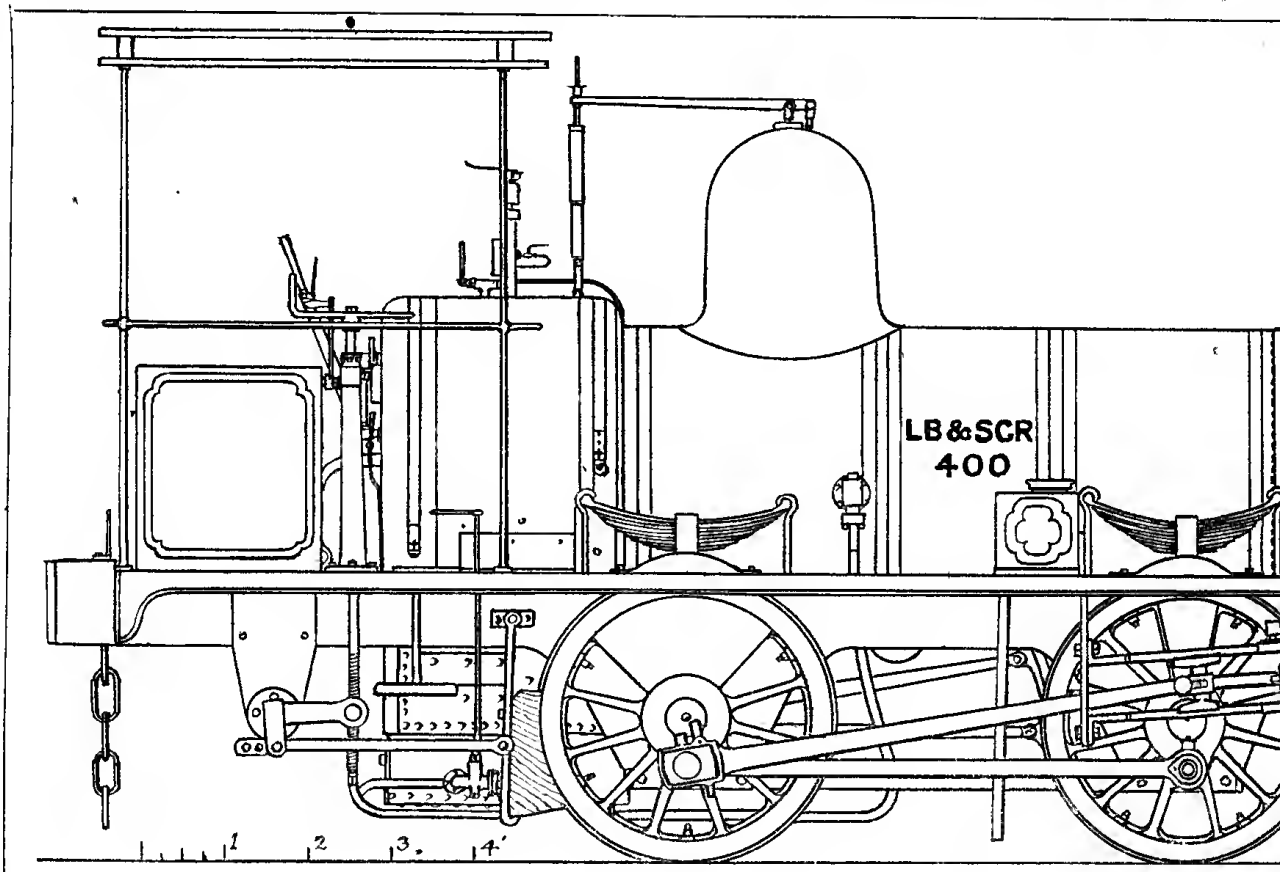
Somehow, I always picture the pattern-makers down at the works. During those far-off heroic days I see them dashing wildly about with plane and chisel in one hand, and in the other a fresh detail-drawing hot from the office. Yet another pattern to be skilfully pieced together! Would there ever be an end to them?

Black Shiny Things

For we must have patterns for castings, as any model-maker knows full well—and what a lot of these lovely black shiny things are needed in the case of a real locomotive. When Craven was in good form and steaming freely, he was quite equal to seven or eight new types of engine in a twelvemonth!

Furthermore, nothing, in his view, must at all resemble anything else that had gone before, and every conceivable sort of scheme for frames, wheels, valves, pumps and other details poured out in full flood. A busy scene indeed.

Incidentally—such goings-on must have created a regular boy's paradise—that steep hill, over which the youthful enthusiast could peep down in wonder on the ever-growing stream of new engines below—each novel in shape. No one knew what might come next—the designer didn't himself —and, after a fill of this entranc-



A sweet little golden engine, certainly one of the most attractive of the "Contractor" type

ing nature, the boy with the same eye for a bit of beautiful craftmanship could slip down to the beach and gaze at the lovely fishing-boats drawn up high and dry, those luggers which R: H. Nibbs, and other fine old water-colourists of their day sketched so sensitively, pictures which are now the pride of the Corporation Gallery. Yes, indeed, it must have been fun to be living in Brighton.

At this time it so happened that an engine was needed to haul the three-coach-express between Polegate and Hailsham, a trip of 2 miles 76 chains.

"Something small," thought Mr. C., "why not then a four-wheeler?—I haven't done one

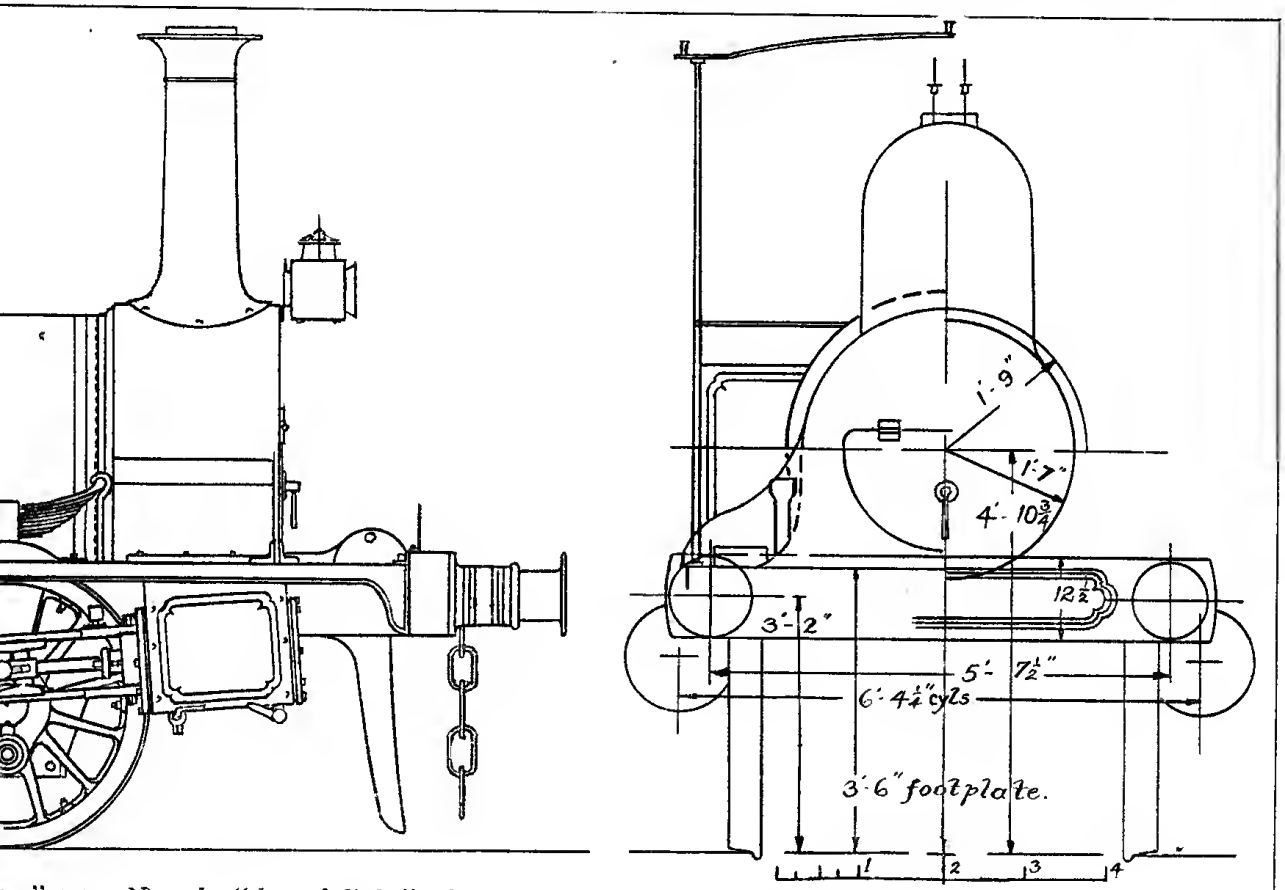
ODELLING by F. C. Hambleton

S.C. Railway, No. 400

before, and, by Jove, it shall be a saddle-tank ; and I'll try chilled-iron solid wheels with cross-section spokes ! " Accordingly, early in the year 1868, No. 27 appeared. It was then only April, but already two other new types had appeared since Christmas !

Good in Outline

Sometimes Craven's engines were passably good in outline, oft-times they were not so good.



tor" type. Note the "launch-links" of the valve gear, and the buffer beam decoration

No. 27 was not so good, but she had one redeeming feature. Being a four-wheeler with outside cylinders, she belonged to the "Noble Order of Contractors' Engines." Now contractors' engines are usually very jolly indeed, the movement of the coupling-rod behind the connecting-rod giving them much the same charm which I mentioned when describing the N.L. Railway goods tank. And in general, they are usually so tiny that as they toddle along they create the same fascination that a pretty little child does with its innocent gambols.

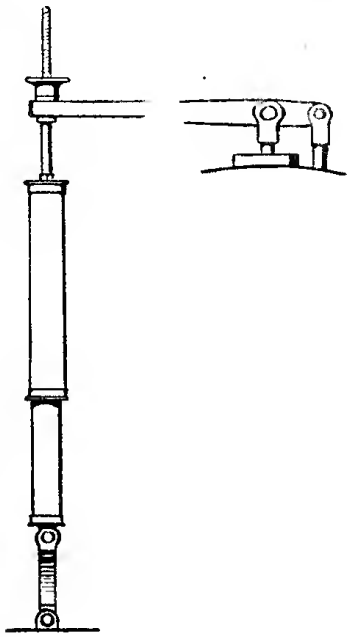
But all was not well with this infant. Little baby 27 lurched about all over the show when puffing along the flat countryside, so she was returned to Brighton to receive a pair of carrying wheels under the footplate. She looked uglier than ever now, and perhaps feeling a change of air would be beneficial, she was packed away to the Littlehampton branch.

Two years after all this, Stroudley and Drummond arrived at Brighton. One can imagine the expressions of the two brilliant young engineers as they proceeded to take stock of their inheritance—" Och, mon !—it's noo a locomotive works—it's a mechanical museum ! " mutters Dugald. Soon, surprisingly soon, the change in leadership could be noticed. In the paint shop, for example, stood a long room of 0-4-2 tanks (" D Tanks," they called 'em) all exactly alike in design, in detail, and in precision of workmanship. These new engines, painted a novel shade of yellow ochre, with sturdy chimneys surmounted by glittering copper-cap (dear me, and all *exactly* alike too) foretold the close of the erratic, "what-comes-next" era. The day of mass production had dawned—at Brighton.

To Pull a Corpse

Stroudley needed a work's-shunter to marshal

these newcomers around the works, and to pull a Craven corpse or two out of the way occasionally. She would have to have a short wheelbase—works' lines always abound in sharp curves. Was there anything suitable amongst the tropical tangle iron at Brighton? Ah! fetch in No. 27 from Littlehampton. Yes, she would do. Out came all six wheels, off came the saddletank, coal boxes, cab-roof, ugly little stove-pipe chimney, buffers and half the brake-gear. Now

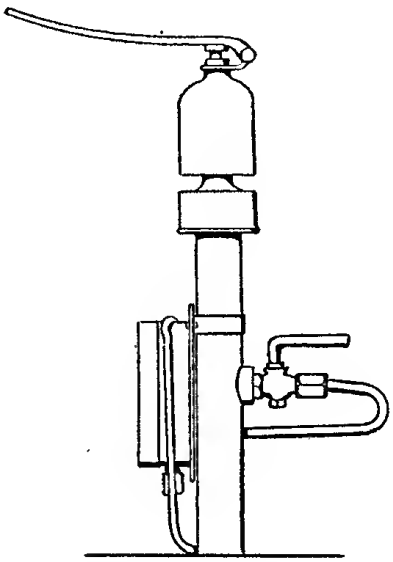


The two safety-valves were attached at their lower ends to a U-shaped bracket

for reconstruction. Four new driving wheels, a well-tank placed between the frames, standard Stroudley buffers, a small coal-box R.H. side, and a beautiful little chimney "Terrier fashion." Then into the paint-shop with her—where she was given "passenger engine" status with coats of yellow ochre and claret framing colours. She didn't get so far as to receive a new brass numberplate—few Craven rebuilds did—but she did receive a new number, i.e. 400, and that, and L.B. & S.C. Rly. with its strangely shaped but characteristic ampersand, were blazoned on the boiler sides in purest gold-leaf. A few days for the decorations to harden, and then, behold, from out of the paint-shop emerged a dainty golden butterfly—the sweetest little four-wheeled engine one could ever wish to see.

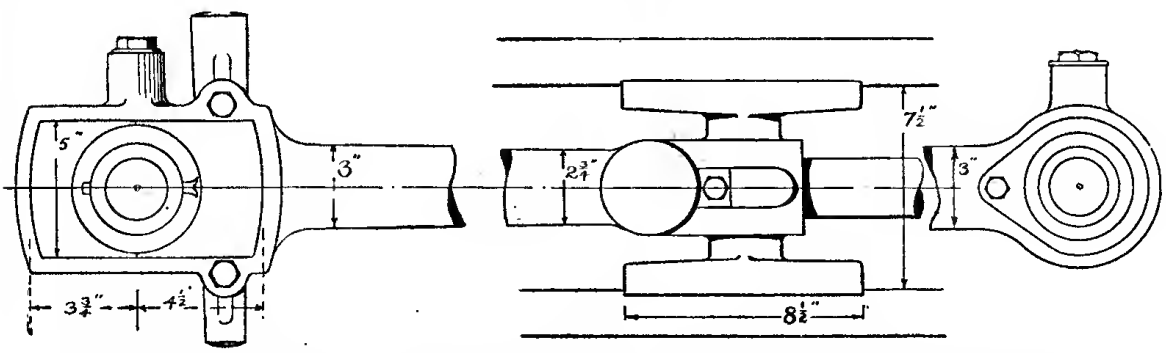
A Closer Look

Let us have a closer look at her. The first thing that strikes us is the curve of the front wing-



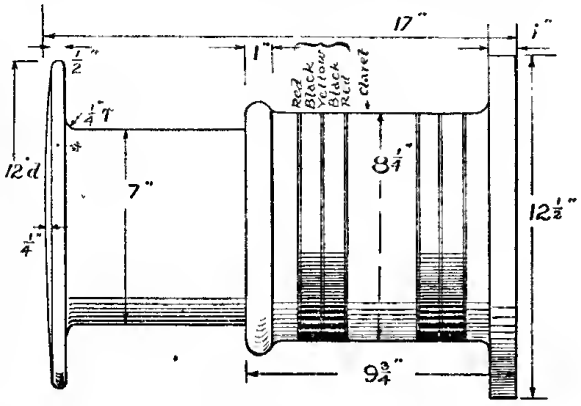
An early form of steam fountain. The whistle handle was quite an artistic effort! The pressure gauge was held in a very convenient position

plate of the smokebox. This gives the front of our little engine a graceful "settled-down" appearance. Above the two diminutive splashers which are bolted down to the footplate, stand the springs. These are held by curved-headed hangers of the form invented by Ramsbottom (quite a number of his ideas, incidentally, seem to have been adopted by Craven). The little sandbox, with its tiny panel of yellow, 6½-in. sq., has the standard Stroudley circular lid—a simple design but, like so many of his details—"just



The six-foot connecting-rod was of typical design, but note the bad position of the crosshead pin, and the unusual connecting-rod small-end

right." The support for the canvas roof (there is no weatherboard at all) consists of the four vertical steel pillars, holding three horizontal roof-rods, and at the 3-ft. level, a continuous rail runs round the sides and back. Notice the absence of boiler handrail. The couple of spring balances held, at their lower end, by a

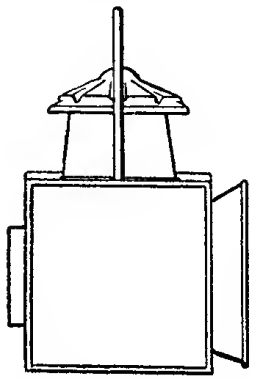


Standard Stroudley buffer, showing the two painted bands

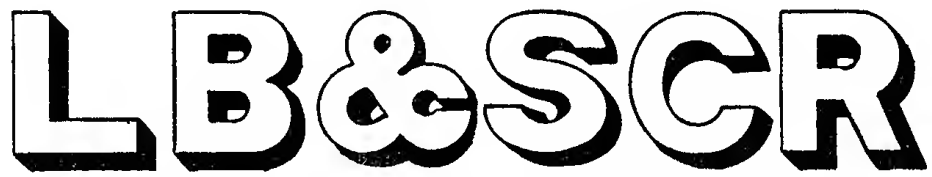
mustard. The edging of panels was olive green.

The boiler bands were black, edged with a fine red line, next a 2-in. olive green band either side, edged next the yellow boiler with a white line.

Sandbox and coalbox ditto. Frame, rich claret edged on the outer side only with a black line having a fine yellow on its outer side and a



The early pattern of the L.B.S.C. headlamp was a generous 8½ in. affair. Stroudley discarded this type about 1874 when he built "Grosvenor"



This handsome 3-in. gilt lettering, with its characteristic ampersand, made a brave show on the boiler of No. 400

common U-shaped bracket attached to the raised firebox, whilst the whistle steampipe also serves as a bracket for the pressure-gauge. Immediately behind this, and within convenient reach, can be seen the blower valve. The handle for the Giffard injector, which No. 400 carried, can also be seen standing just above the footplate. Beyond the new 3-ft. 5½-in. wheels, Stroudley altered very little below footplate level. A couple of leading guard-irons, and his buffers constituted the changes, and, of course, the well feed-tank. There is no rod connection for sanding gear, nor for the cylinder cocks, and if you want to clear any condensed water out of the cylinders, the only way is to jolly well jump down, open the cocks and run alongside until all is well! But that, after all, is of not much account in a works' locomotive.

Painting

Now for some comments on the painting. It is said that the celebrated Stroudley yellow was a mixture of Oxford ochre, chrome, white and oxide. The result should be a colour somewhat between newly-mixed and stale

fine red on its inner side. Buffer sockets claret, crossed by two 1¾-in. black bands. Each had a yellow line down its centre and red stripes on either side.

Buffer beams claret, with vermilion centre-panel, separated by a thick black band, which had a yellow centre stripe, a white stripe next vermilion and a red one next the claret. Spokes and hubs yellow, with axle ends and tyres olive green. By 1879 heavier engines were being built at Brighton, and little 400 was sent off to Redhill goods yard in March. Her days of usefulness in the works had come to an end. However, she lasted till 1896, when she was scrapped at Horley, and the little "Contractor" type engine vanished for ever from the L.B. & S.C. Railway.

Useful Dimensions

Cylinders 9 by 14 in.; steamports 1½ and 2½ by 7 in.; front overhang, 4 ft. 10½ in., rear overhang, 6 ft. 10½ in.; rail to chimney 10 ft.; boiler, 2 ft. 11 in. diameter by 8 ft. 10 in.; dome, 1 ft. 9 in. diameter, by 2 ft. 3 in. Total heating surface 318 sq. ft. Weight, leading 9½ tons, trailing 5 tons 12 cwt.

PETROL ENGINE TOPICS

*A 10 c.c. Flat Twin Two-Stroke Engine

by Edgar T. Westbury

THE connecting-rods (Fig. 12) are of light alloy, and may be made either from castings, or machined from the solid ; the latter is recommended for high duty, as it enables alloys of the highest possible tensile strength to be used, such as duralumin or hiduminium. However, rods cast in really good alloy have been found to stand up well in high-speed engines, though the tensile strength of castings is considerably less than that of rolled or forged alloys.

Both rods must, of course, be exactly the same length between centres, and the other main essential point is that the bores of the eyes should

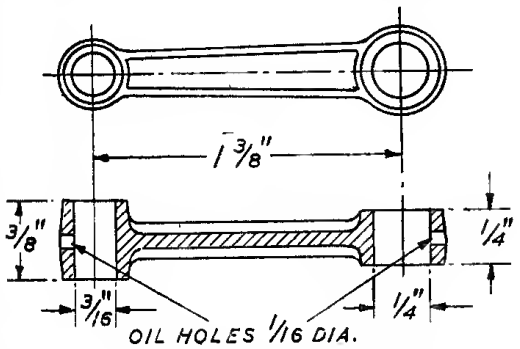


Fig. 12. *Connecting-rods* (2 *off, light alloy*)

be exactly parallel with each other ; any means of machining which will positively assure this will be satisfactory. In machining small connecting-rod castings, I find it convenient to clamp them by the centre web to a flat steel plate, which is then shifted on the faceplate as required to bring each eye in turn central for boring.

In the case of rods machined from the solid, fluting the sides is optional, but desirable to reduce reciprocating weight while retaining maximum strength. For best possible balance, the rods should not only weigh exactly the same, but should also have their centre of gravity at the same point in the length.

Constructors who prefer to use a solid, one-piece crankshaft will, of course, have to use connecting-rods with split big-end bearings. Owing to the need for keeping down the volume of the crankcase, it will be found that the usual bolted big-end of the automobile or marine type cannot be accommodated, and it will be necessary to fit a bearing of the "strap" or locomotive type ; if further information is required on this point, I will give a drawing of a suitable type of rod later, though I rather hope that most readers will agree with me that a split crankshaft and solid-eye big-ends as specified are preferable.

*Continued from page 349, "M.E.," April 1, 1948.

Main Bearings

These are plain gunmetal bushes of the dimensions shown in Fig. 13, and are best made by turning and boring at one setting from a piece of cast stick, then parting off. The outside diameter should be a moderately tight interference fit in the bore of the housing (that is, about 0.001 in. larger than the hole), and if thus fitted there should be no risk of them ever shifting inadvertently, though the possibility may be completely eliminated by lightly knurling about $\frac{1}{4}$ in. of the length with a straight-cut knurl—not a diamond or any other fancy knurl, on any account !

It will be seen that the flange of the bush is only $\frac{1}{16}$ in. larger in diameter than the rest of the length, the reason being that the rotary valve runs on the outside of one flange, and it was thought desirable to keep both bushes uniform in dimensions. It is, however, possible to use a larger flange on the front bush if desired, and this is recommended if the shaft is required to take end thrust, as when driving a tractor airscrew on this end of the shaft. Should the thrust be the other way, however, the rotary valve forms a most effective thrust bearing. Note that if the flange of the front bush is enlarged, the recess in the front housing must also be bored out to take it ; there is no need to make it a close fit, but make sure it will go in before pressing the bush home.

A liberal radius or chamfer should be machined in the inner (flanged) end of the bush, to clear the fillet of the main crank journal ; make certain that the shaft will go right home to the flange

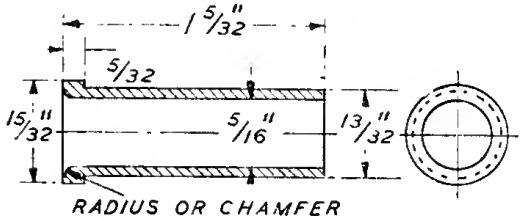


Fig. 13. *Main bearing bushes* (2 *off, bronze*)

of the bush without binding. The bushes will contract slightly when pressed in, so after assembly, a reamer should be passed right though both bushes to correct the size and ensure perfect alignment. Oil ways in the bushes have not been found necessary, on the other hand, they may if anything tend to encourage leakage of the bearings under the pumping action of the crankcase.

Rotary Valve

In this engine, as in the "Kestrel" and certain others of my earlier engines, the valve

disc runs in close proximity to the crank web, and it is necessary to locate the port in such a position that it is not partially or completely blanked by the web and balance weight. Apart from this, there is little about the component which calls for comment. It may be made either from steel or cast iron, the latter having the best wearing properties, though the load is so light and lubrication so copious that almost any material will work reasonably well, and I know

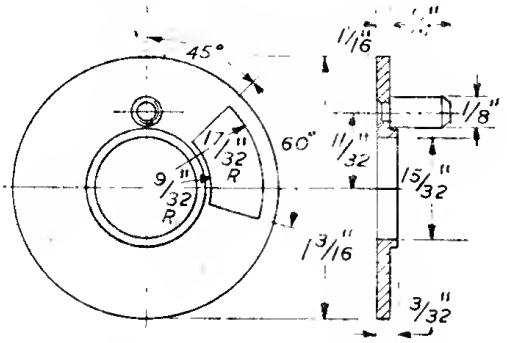


Fig. 14. Rotary valve (1 off, steel or cast-iron)

of cases where duralumin valves have been used quite successfully. I cannot, however, see much advantage in using them except when one is splitting hairs over weight.

The driving pin should be riveted in, and filed flush with the face surface of the disc, before finishing it by lapping, or other means to ensure dead flatness. To locate the driving pin at exactly the correct radius to fit inside the hollow crankpin without binding, the half-crank may be used as a jig, by fitting the rotary valve in position over the main bush flange and inserting the crank journal in the bush. A $\frac{1}{8}$ in. drill passed through the crankpin will then "spot" the disc accurately in respect to radius, and if care is taken in fitting the pin it will be exactly perpendicular to the disc. The pin centre may, with advantage, be taken as the zero point for setting out the angle and location of the port, which may be produced by milling, or drilling and filing.

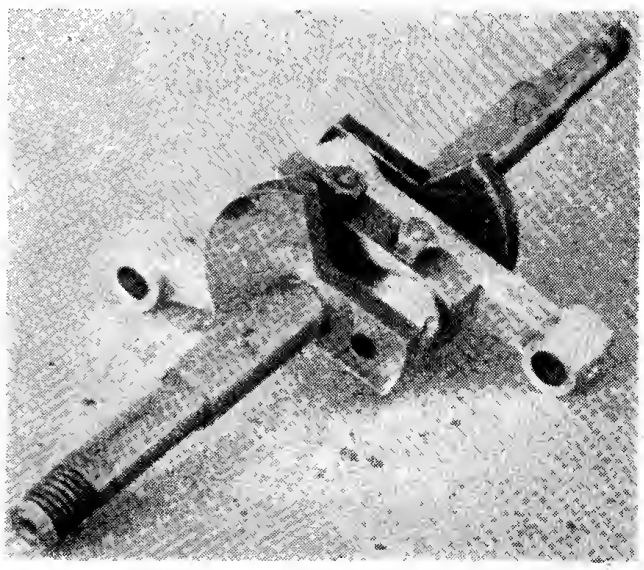
I have on several occasions referred to the advantages of balancing the rotary valve; the benefits are to be found mostly in impoved wear of the valve pivot or spindle, rather than the effect on the general engine balance. When a disc or other rotating body is running out of truth, at high speed, it tries hard to establish dynamic balance about its true centre of gravity, with the result that the pivot, or spindle is forced to one side, and both it and its bearing wears abnormally. On several occasions I have found the disc bearings of engines wearing oval, and on one occasion, in an "Atom Minor" engine fitted with a hardened steel valve, the disc split when running at r.p.m. somewhere near the 20,000 mark—it is believed due to this cause.

Balancing of the disc may be effected by leaving a rim on the outside, and filing it away on the heavy side. The inner rim of the disc should be machined to such a thickness that it stands slightly proud of the flange face of the bush, so that any end thrust is taken on the disc.

Carburettor

This is of fairly conventional design, and most of its features have much in common with those of other carburettors which have been described previously. The body, or mixing tube, may be made either of brass or duralumin, most of the other parts being preferably of brass, except the jet needle and the check spring. It will be seen that the body is cross drilled in the usual way, but instead of spot-facing the sides of the hole, flats are milled or filed so as to leave a square-sided groove both top and bottom. The object of this is to provide a location for the hexagonal head of the jet tube, and prevent it from rotating. Trouble is often caused by the inadvertent rotation of the jet tube, especially when the cross hole for fuel discharge is drilled only in one side, and must therefore face towards the discharge end of the mixing tube, as in the present case.

The jet adjusting screw is of usual form, of ample diameter to facilitate fine adjustment, and the needle, which may be of German silver, phosphor-bronze, or stainless steel, is soldered in after assembly. An alternative method is to screw the top end of the needle 10 B.A., tapping the adjusting head to suit, and screwing it in tightly from the underside, then lightly riveting the top. This is a more certain method of fixing than soldering, but be certain that it is sufficiently tight on the threads to avoid risk of turning round



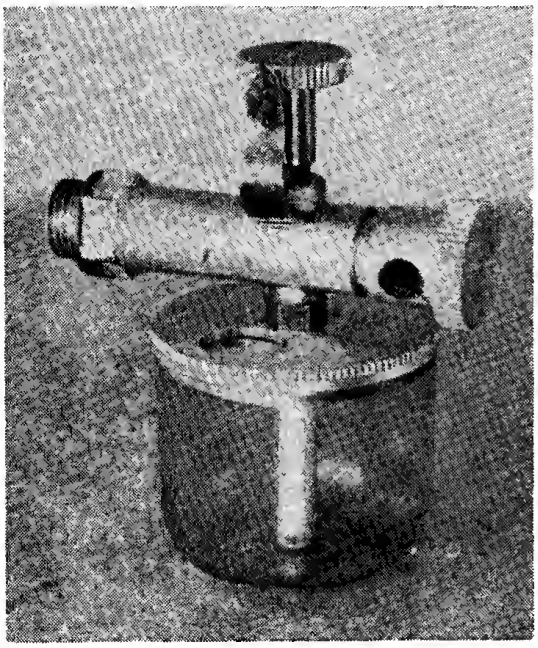
Crankshaft and connecting-rod assembly

and producing a secondary and accidental alteration of setting.

Air control is, of course, optional, but desirable; the simple air cap shown is quite effective, and will not only assist starting but also enable the

engine to be adjusted to tick over if desired. It will be seen that the lip of the cap is turned to a knife-edge, and after assembly on the body, this is spun into the groove in the latter to retain the cap in position. This operation is best carried out after machining the cap, but before parting off, and the best tool to use is a burnisher, made like a narrow round-nosed tool without any cutting edge. It should be well lubricated, and pressed against the lip by hand, using a rest of some kind as for hand turning or chasing.

In an alternative method of retaining the cap, the check spring was made with an extension each end, one end being used to lock the jet adjustment as usual, and the other projecting horizontally beyond the end of the cap, and turned down at right angles, thus providing both a friction lock and a retainer.



Carburettor, fitted with transparent bowl-type reservoir

The holes in the cap and body may be drilled after assembly, being preferably drilled undersize and opened out with a taper reamer, which will line them up neatly, and remove burrs which might interfere with the smooth action of the control.

It will be seen that the lower end of the jet tube is screwed to take a union joint ; this again is an optional feature, and some constructors may prefer other and possibly simpler methods of connecting the feed pipe. I may observe, however, that I have a rather deep-rooted aversion to the common but slovenly method of using rubber or " synthetic " tubing for the full length of the line, though it is quite in order to use it as a sleeve coupling to introduce a little flexibility in a metal pipe line.

The use of a bowl-type fuel reservoir immediately under the jet is convenient when it is desired to keep the engine self-contained, and has been adopted in the example illustrated ; it is attached simply by means of a hollow extension bolt, screwed into the inside of the jet tube at its lower end, the bowl being retained by a blind nut. A hole is drilled across the bolt at the lowest possible point inside the bowl, and the metal cover of the latter is provided with a filler orifice and an air vent. The capacity of such a reservoir is somewhat limited, and a separate and larger tank is preferable when the engine is fitted in a boat or car.

Minor Discrepancies

Some intending constructors may have seen that these drawings do not coincide in every detail with those issued by Craftsmanship Models Limited in conjunction with the sale of the castings. This does not necessarily mean, however, that one or the other must be wrong. In the course of development of this engine, many variations of details and accessories have been tried out ; all of them work, but some of them are simpler or more convenient to produce, or have other particular advantages in specific instances. Some minor modifications have been adopted independently by the above firm, and they have issued drawings before my own drawings were completed, in order to satisfy the requirements of constructors who were anxious to get busy on the castings. It is not, therefore, a matter of who is right or wrong, but just slightly different interpretations of the same design, and constructors may be assured that either will give essentially the same practical results.

A Call to Arms !

Now that preparations for this year's MODEL ENGINEER Exhibition are well under way, it occurs to me that a gentle exhortation to model petrol engine constructors to get their models ready for this event will be in order. For some years now, representation of these models at the Exhibition has been on the decline, and last year there were only three models entered in the Internal Combustion section. If it were true that these three models did in fact constitute a representative cross-section of the activity of model petrol engine constructors throughout the country, then *Petrol Engine Topics* would be a waste of the valuable space in THE MODEL ENGINEER, and yours truly would be but a voice crying in the wilderness. But the facts are very different, and there are numerous examples of model petrol engines under construction or completed all over the country. In the course of the many visits I make to model engineering clubs, I rarely fail to find at least one or two very worthy examples of petrol engines, and I not infrequently run across something quite outstanding in this line.

There are altogether too many lights hidden under bushels, and I appeal—nay, demand !—that some of them be brought out into the open. The old excuse that petrol engines do not stand a chance against more spectacular types of models in an exhibition is no longer valid, as these models are judged in their own section, and with due understanding as to their essential features which do not appear on the surface. Transport of these models is by no means such a difficult problem as

that of heavy or bulky models such as locomotives or ships, yet the latter always get to the Exhibition in large numbers.

For what it may be worth, I may mention that the pooling of special prizes, which was tried experimentally last year, is not to be rigidly adhered to this time, and therefore the small prize which I usually offer, for originality in model petrol engine design, will again be available, and there will possibly be others, in addition to the normal merit awards of medals and diplomas.

But far be it from me to dangle these baits like carrots before a donkey—the "pot hunter" is not the type I wish to encourage, but the enthusiastic constructor who does a sound job of work because he is interested in good design, good workmanship and progress. There are hundreds of these in the country, to my knowledge, and I look forward to seeing the results of their enterprise at THE MODEL ENGINEER Exhibition in due course.

(To be continued)

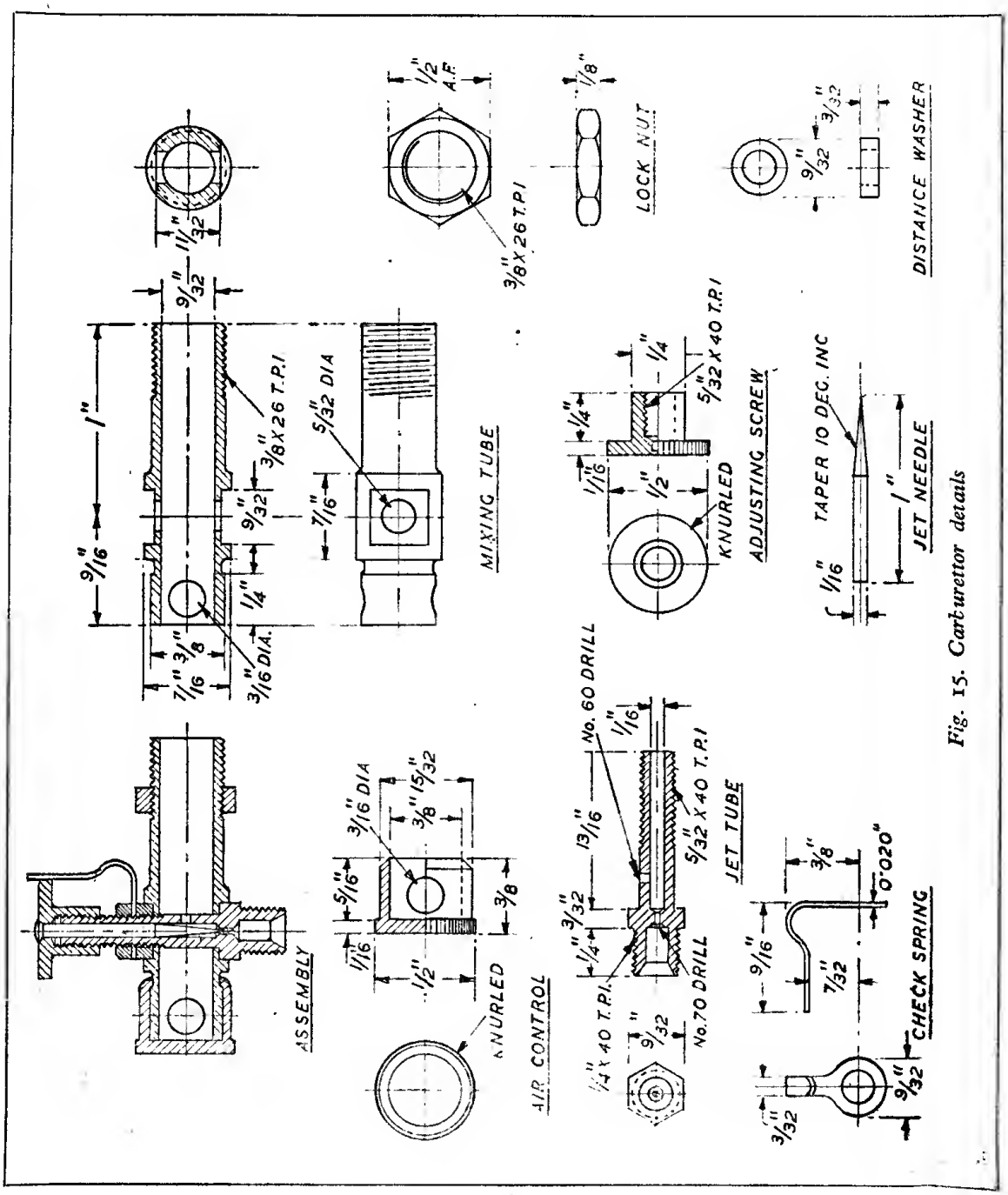


Fig. 15. Carburettor details

A Sharpening Tool

For maintaining the correct angle on chisels and plane irons when grinding and stoning

by J. W. Tomlinson

ANYONE who has stoned a chisel or plane iron knows the difficulty experienced in keeping the tool to the same angle ; this applies also when grinding these tools. To start at the beginning, the chisel is ground to the correct angle and is then finished on an oilstone. The first time it is stoned the angle is fairly easy to find, but in most cases more pressure is applied at the cutting end which saves sharpening the whole of the cutting angle and gives a keen edge in less time. The second time the chisel is stoned, the same thing happens, so that after a few stonings, the chisel looks something like the one shown in Fig. 1,

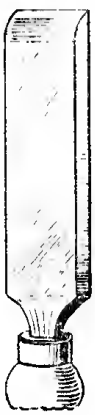


Fig. 1.
Badly sharpened chisel

and it is ready for re-grinding. Now this means the use of a grindstone and excessive wear on the chisel, not to mention the loss of time.

In an effort to avoid all this, the writer has designed and made the tool described in this article, which can be made from odd scraps to be found in the workshop, and these few paragraphs and illustrations show how to make and use it.

The tool is adjustable so that chisels and plane irons can be ground or stoned at any angle, ensuring a perfectly flat surface. It should be noted that the novelty of the tool is the spring-loading. The chisel is clipped to the main body of the tool which is spring-loaded to the base, this being so, when the tool and chisel are run along the oil stone and a downward pressure is applied, the chisel goes down on the stone, independent of the base.

The base runs along the stone on its own case-hardened rollers, keeping the chisel steady and square. A few sharp rubs backwards and forwards, and the chisel is perfectly sharp. The chisel grip is a quick-fastening cam-type and is adjustable for different thicknesses. Any sized tool can be made provided an oil stone can be found to fit it. The tool described here is suitable for chisels and plane irons up to $1\frac{1}{2}$ in. across.

How to Make

Details for making the tool are shown in Fig. 2 to Fig. 8. The body base can be made from duralumin or steel, whichever is convenient. Care should be taken when cutting the slot, as this must be parallel with the sides and accurate in width. The two holes near the bottom are for rivets and they must match up with the slots

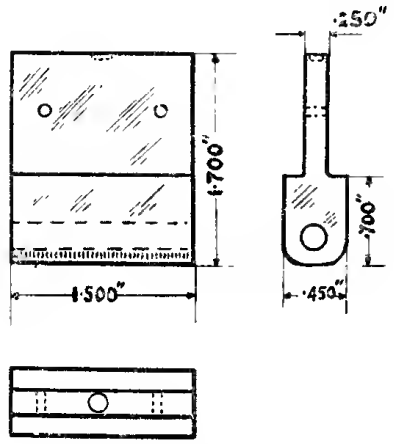


Fig. 2. *Body base*

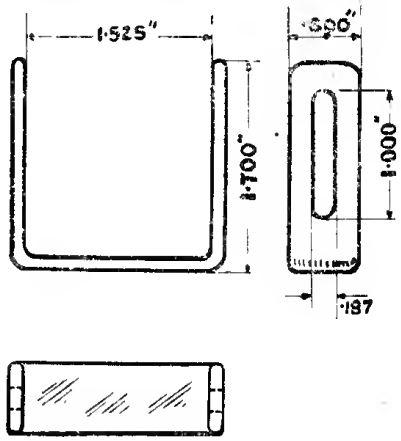
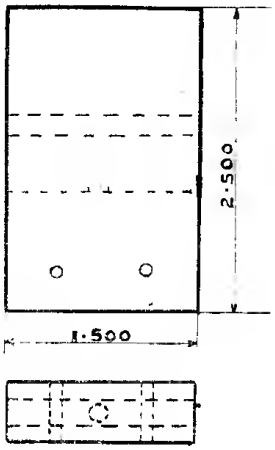


Fig. 3. *Grip support*

in the body base. The body base should be made of the same material as the body, and the same care should be exercised in the making. The base should be made a good sliding fit into its mating part, and the two slots can be marked off from the holes in the body. When the rivets are in position, there should be approximately $\frac{3}{16}$ in. up and down movement. A small counterbore is put in the top of the body base in line with one in the top of the body slot, these are to keep the spring in position.

A $\frac{1}{4}$ in. hole is drilled transversely through the body base, to accommodate the securing bolt. The base sides are made of steel, and it will be noticed that the $\frac{1}{4}$ in. hole for the body base securing bolt is not in the centre of the base. This is to bring the chisel in the centre of the tool and give it balance and ease of handling.

The chisel cam grip is made of steel, and when it is being drilled, it should be noted that the hole is eccentric. This is to give the cam effect. The rollers can be made of standard sized steel tubing, and although case-hardening is desirable, it is not essential, as the writer has used soft rollers for many months with very little wear



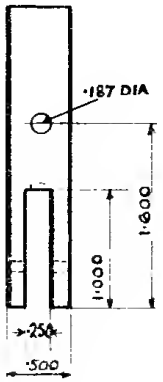


Fig. 4. Body

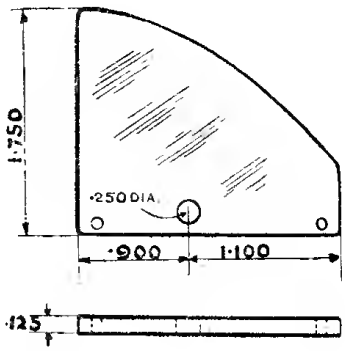


Fig. 5. Base side (2 off)

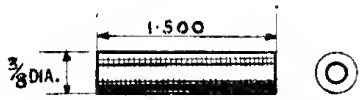


Fig. 6. Roller (2 off)

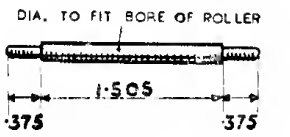
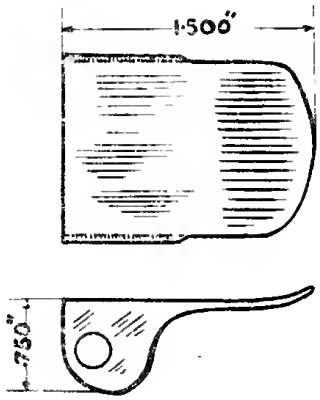


Fig. 7. Roller spindle (2 off)



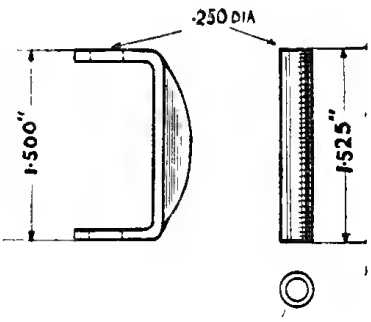


Fig. 8. Cam grip and tube

taking place. The remaining details are quite simple to make and are clearly shown on the drawings.

The spring should be of moderate strength so that when it is in position it requires two or three pounds pressure to squeeze the body base and the body together. When assembling, insert the spring between the two parts, press together and fit the two rivets. Check for freedom, peen over the rivets and file flush with the body.

Next, smear the roller spindles with oil and slip on the rollers. Insert these between the two base plates and fit the four spindle nuts. Fit the tube into the cam grip making sure that it is slightly longer than the width of the grip. Fit the grip and tube into the grip support, thread the bolt through and fit the nut. Slip the grip and support over the body-piece and retain with the transverse bolt. The nut must be left slack, allowing the support to move freely in its slot. After the nut is fitted, the bolt end should be lightly peened to retain the nut.

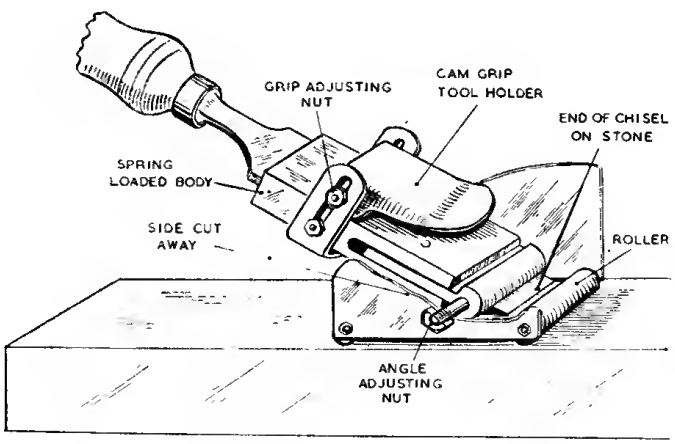


Fig. 9. Main details of tool

The body is then fitted to the base and made secure with the ¼ in. transverse bolt. This completes the assembly. If it is thought desirable, thumb-screws can be fitted to the two adjusting bolts; also, the side of the body contacting the chisel can be knurled to ensure a better grip.

How to Use

First set the chisel grip. To do

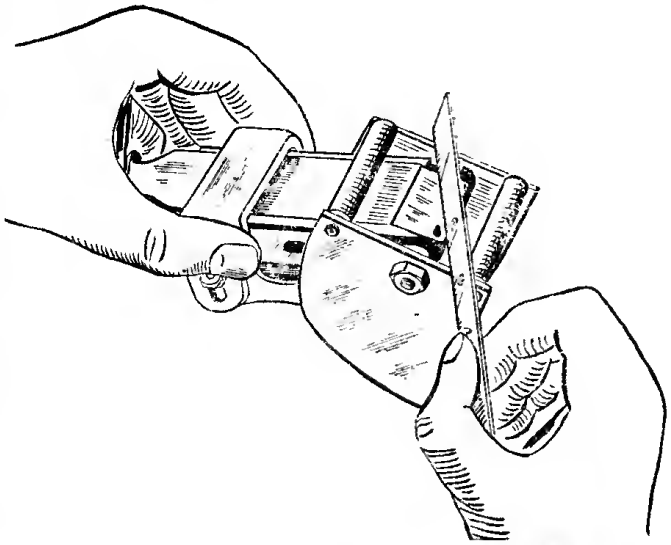


Fig. 10. *Setting the angle*

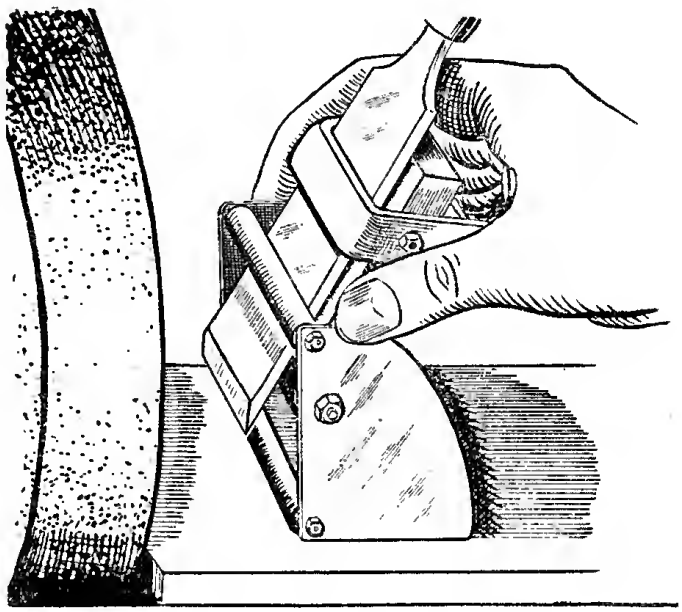
this slack off the adjusting nut (see Fig. 9) slip the chisel in position and with the grip open (pointing upwards), tighten the nut. Next, set the angle. Push the grip downwards locking the chisel, turn the tool over, slack off the ¼ in. nut in the side of the base and adjust to bring the chisel square with the base sides. This can be checked by holding a rule across the base sides and chisel, as shown in Fig. 10. If the chisel is less width than that of the tool, it should be brought to one side before it is locked in position; this will keep the chisel square with the stone.

For re-stoning, place the tool on the stone, slip the chisel in position, allowing the cutting angle to touch the stone. Draw the tool and chisel several times up and down the stone, applying a light downward pressure. Remove the chisel and draw the back side lightly down the stone to take away the burr. The chisel should now be perfectly sharp.

Grinding

To grind the chisel accurately, slip it into the tool, allowing it to protrude past the base. Lock it in position and hold the tool and chisel to the side of the grindstone, keeping it square on the rest, as shown in Fig. 11.

Below—Fig. 11. *Grinding to correct angle*



Modifications for the M.L.7 Lathe

(*Continued from page* 403)

will give approximately 1/1000 in. per division.

The tip of the screw should be hardened, and the pin in the tailstock against which this screw abuts should be removed and case-hardened.

Although it is not possible to use this vernier to turn to a predetermined vernier, it is a great help in adjusting to a given taper, and in conjunction with the rear scale enables the tailstock to be returned to a central position with accuracy.

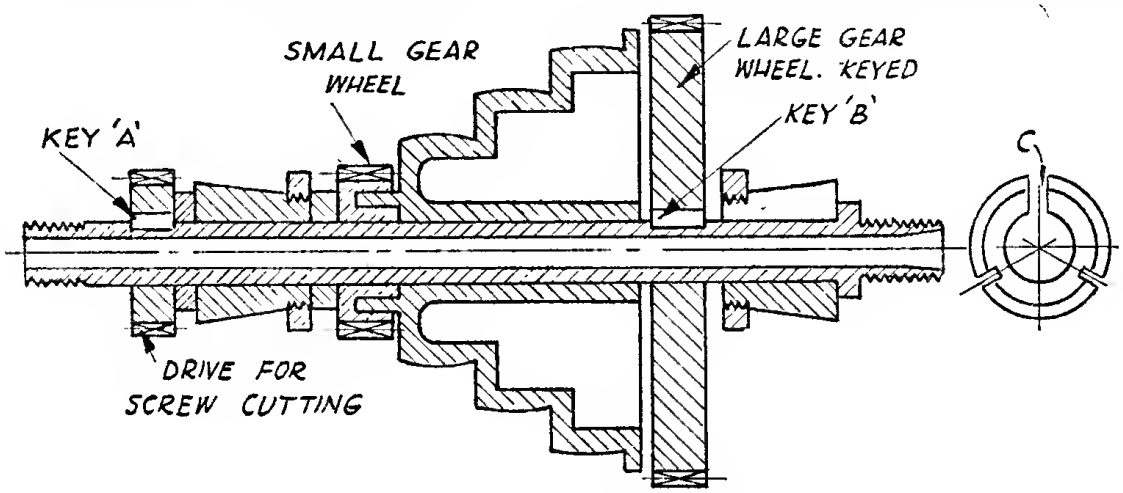
To do this, first centralise the tailstock accurately by the usual methods, tighten up the adjusting screws as would normally be done, and make a note of the vernier reading. No cursor is fitted, as this is not practical, but a sighting mark can be made on the side of the tailstock, and the vernier aligned with this and its screw.

The central reading having been noted, on future occasions it is only necessary to unscrew the vernier until it is the same, and then tighten up the opposite adjusting screw. It is important to remember that the vernier screw may have to be rotated a number of times, and to be certain that it has been rotated the correct number of times, rough centralisation should be made by the aid of the scale on the back of the tailstock.

Editor's Correspondence

Removing Lathe Mandrel

DEAR SIR,—*Re* the letter in the March 4th issue, "Removing Lathe Mandrel," I have an old 5-in. Drummond lathe which, I think, is the same as the lathe in question. The gear-wheel on mine was not unduly tight, but I had some trouble in removing it, the bearings being badly worn.



The trouble is, the key has to go through the front bearing, which has a slot right through in one place. This bearing should be held back while driving out shaft. I give a sketch which explains this (I hope).

Key "A" must be removed first.

Key "B," I believe, goes through slot "C" in bearing, at the top, as shown.

I should be pleased to give any further information.

Yours faithfully,

Boston. R. JAQUES.

DEAR SIR,—Replying to Mr. Hawthorne's letter *re* mandrel of old type 5-in. Drummond lathe, I have one of these which I purchased about forty years ago. I have never had occasion to interfere with the headstock bearings and so cannot give him any definite information, but I think I am right in saying that the bearings are not taper, but that the housing is, and if the large gear-wheel is wedged so that it cannot touch the bush, it should be quite possible to drive the spindle out.

Yours faithfully,

Bury. HENRY N. OPENSHAW.

Old Traction Engines

DEAR SIR,—I would like to comment on W. J. Hughes' article in the 20th November, 1947, issue, it was a great help to traction engine enthusiasts who may be in the throes of building a Fowler "Big Lion," as I am. My Burrell completed, I had to have a go at another. Particularly interesting is his note on gear changing, and mentioning that it would be interesting to know, as there were two engines converted, what happened to the other; well, I believe I can supply the answer. There was for a long while a Fowler not far from here, owned by Danters, of Swansea, and I believe, bearing the name "Pride of Wales." I have inspected this engine a number of times and noted two things out of the ordinary on her; first, the gear-change described by Mr. Hughes, and second, the front wheels were double T-rings, as on the rear, which I have never noticed on other showmen's engines. I regret to say that a matter of a few months ago "Pride of Wales" met the same fate as a good many others, scrap! Danters had two engines, the other, "King George V," can be seen at work on wood-cutting in Swansea docks, but I am informed that her life also is drawing to a close.

Yours faithfully,

Milford Haven. G. THOMAS.

"A Westbury Winner"

DEAR SIR,—It occurs to me that some of your readers may be interested in my experiences in making the Atom Minor Mark III petrol engine. I am 17½ years old and obviously cannot claim much previous experience on the making of model engines, but I found that, with the advice and guidance of older and more experienced model makers, I was able to construct this unit without very much difficulty. Spending about three or four hours a week on the job, it took some twelve weeks to finish, but this included time spent, I am sorry to say, in correcting some faulty machining. However, I have found it most interesting work and have learned a good deal from it. What is more, the engine works. It works very reliably and gives no trouble when starting. In fact, it is a credit to the designer.

Yours faithfully,

Surrey. HOWARD D. STONEHOUSE.